Strong Pit
Abbotsford, BC

Agricultural Reclamation Plan

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solve and simplify

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List of Acronyms

ASL	-	above sea level
ALC	-	Agricultural Land Commission
ALR	-	Agricultural Land Reserve
EC	-	Electric Conductivity
ESC	-	Erosion Sediment Control
FVA	-	Fraser Valley Aggregate
Golder	-	Golder Associates Ltd.
MOTI	-	Ministry of Transportation and Infrastructure
PGL	-	PGL Environmental Consultants

1.0 INTRODUCTION

PGL Environmental Consultants Ltd. (PGL) was retained by the Ministry of Transportation and Infrastructure (MOTI) to prepare an agricultural reclamation plan for the Strong Pit in Abbotsford, BC (the Site) to meet the conditions of their Agricultural Land Commission (ALC) approval and facilitate potential future divestiture of the Site.

1.1 Background

The Site is south of King Road and west of Bradner Road in Abbotsford and consists of two properties (1461 and 1505 Bradner Road) totalling 47.54 ha, within the Agricultural Land Reserve. Strong Pit is an active extraction operation, which MOTI intends to reclaim for soil based agricultural use upon completion of activities as required by the Agricultural Land Commission. Reclamation will be achieved utilizing stockpiled soils currently located onsite as well as imported soils to construct a reclaimed soil profile suitable for soil-based agriculture.

MOTI previously retained Golder Associates Ltd. (Golder) to develop a single reclamation plan for both properties. MOTI is currently assessing the potential of divesting the properties separately and therefore requires preparation of a reclamation plan to facilitate progressive reclamation.

As part of Golder's assignment (Golder, 2016), they assessed the reclamation suitability of 18 stockpiles containing approximately 1,534,000m^3 of salvaged and previously imported soil. The stockpiles are to be utilized for reclamation purposes to prepare a soil profile suitable for soil-based agriculture.

Golder estimated that approximately 329,200m^3 of soil from stockpiles SP3, SP6, SP11, and SP18 are suitable for root zone use. Approximately 90,000m3 of soil in stockpiles SP15 and SP17 were not evaluated as they were considered inaccessible. The remaining material was considered suitable for a drain layer or bulk-fill and was not suitable for root zone use.

1.2 Agricultural Land Commission Reclamation Plan Requirements

The Agricultural Land Commission has developed the Reclamation Plans for Aggregate Extraction (Policy P-13) to guide reclamation requirements.

The ALC has identified the following components for inclusion in a reclamation plan prior to initiation of aggregate extraction, which include:

1. A detailed soil survey and agricultural capability analysis of the land(s) impacted, including potential soil bound crop options, and any affected or potentially affected neighbouring properties at an appropriate scale (as per ALC Policy P-10). All existing resource information such as government soil survey and agricultural capability mapping must be included and discussed in the context of the detailed survey;
2. An inventory and description of the existing land use on the subject land(s) and surrounding lands;
3. Detailed Site preparation, operating and reclamation activities in-line with the Agricultural Land Commission's Best Management Practices for Aggregate Extraction. This should include, but is not limited to, the following elements:
    a) Plans and sections showing original undisturbed grades, current grades (if different from undisturbed grades), final grades in relation to adjacent natural grades, volume of

aggregate to be removed, and proposed slope gradient (%) drawn at an appropriate scale and prepared by a Professional Engineer or Registered BC Land Surveyor;
b) A topsoil management plan addressing stripping, storage, and replacement of soil;
c) A plan for phased operations and reclamation (if applicable);
d) If backfilling pit areas with fill imported from offsite is being proposed, fill certification procedures and site control measures to ensure that only clean fill material is accepted;
e) Erosion control measures;
f) A weed management plan;
g) A plan for crop/agronomic vegetation establishment;
h) Detailed drainage plans for the rehabilitated site to ensure optimum surface and subsurface drainage conditions;
i) Final proposed agricultural capability; and
j) Closure procedures and certification of the work.

1.3 Reclamation Objectives

The end land use is agricultural; therefore, reclamation should focus on restoring gentle landforms, establishing equivalent drainage, and reconstructing an acceptable soil. As the Site is in an area of high-quality farmland, the land must be returned to an equivalent agricultural capability and achieve a final Site condition that is similar to pre-extraction land capability.

The closure objectives for the Project have been guided by the four closure principles outlined in the Ministry of Transportation and Highways Reclamation and Environmental Protection Handbook for Sand, Gravel and Quarry Operations in British Columbia (1995). Closure objectives and criteria are provided in Table A.

Table A: Project Closure Objectives and Criteria

Closure Objective	Closure Criteria
Site Clean-Up	All remaining debris and garbage must be removed from Site
	Do not bury any waste onsite
	Burial of boulders at depth
	Weed control
	Remediation and confirmatory sampling is required for any fuel or hydrocarbon contamination
Establishing Final Elevations and Backfilling	Final elevations should compliment adjacent landforms
	Provide a smooth transition between land contours and drainage channels
	Side slopes should be graded back and recontoured to blend in with adjacent natural contours
	Achieve ideal slope of 2H:1V
Drainage and Erosion Control	Final slope grading to minimize erosion potential
	Maintain positive drainage
Topsoil and Subsoil Replacement	Best quality soil materials placed in rooting zone, with poorer quality soil placed at the base of the quarry
	Spread soil materials evenly across disturbed sites
Soil Compaction and Crusting	Minimize use of rubber-tired equipment, which can compact and destroy soil structure
	Do not handle soil when wet
Vegetation Establishment	Restore capability of land and provide erosion control
	Broadcast or drill seeding
	Test reclaimed soils for nutrient requirements
Maintenance and Monitoring	Ditches, French drains, and detention ponds need to be cleaned out regularly

2.0 SITE DESCRIPTION

The Site includes two parcels with a total area of 47.54 ha located on the south side of King Road, west of Bradner Road (Figure 1). Strong Pit has experienced extraction activities across almost the entire area of both properties producing a complex terrain resulting from extraction and stockpiling activities. Access to Strong Pit is off King Road along the western edge of 1505 Bradner Road. Internal gravel access roads run throughout the two parcels (Appendix 1).

Aggregate extraction has occurred along the entirety of the western portion of 1505 Bradner Road. Preliminary regrading has occurred in this portion of the pit. The easternmost portion of 1505 Bradner Road is utilized for rural residential purposes and is located at a similar elevation as surrounding parcels not used for aggregate extraction.

While 1505 Bradner Road is primarily characterized by an open aggregate pit, 1461 Bradner Road is characterized by a mixture of mined out portions of the site, the northern and western portion of the parcel are covered in stockpiles of stripped soil originating from onsite as well as stockpiled imported soil. Soil origin is discussed in Section 4.3.

2.1 Legal Description

The legal descriptions of the parcels are provided in Tables B and C.

Table B: Legal Description – 1461 Bradner Road, Abbotsford, BC

Civic Address	1461 Bradner Road, Abbotsford, BC
Parcel Size	37.69 ha (93.13 acres)
Legal Description	Lot 1, Part NE 1/4, and NW 1/4, Section 9, Township 13, Plan 67442, NWD
Property Identifier	002-363-372

Table C: Legal Description – 1505 Bradner Road, Abbotsford, BC

Civic Address	1505 King Road, Abbotsford, BC
Parcel Size	9.85 ha (24.33 acres)
Legal Description	Lot N12.5 CHNS, Part NE 1/4, Except Plan 12137 & 15689, Section 9, Township 13, Plan N 1/4, NWD
Property Identifier	007-276-028

2.2 Site Zoning and Land Use

The properties are located with the Agricultural Land Reserve (ALR) and are zoned by the City of Abbotsford (Figure 2) as:

- 1505 Bradner Road – Agricultural One Zone (A1); and
- 1461 Bradner Road – Agricultural and Resource Processing Zone (A3).

Agricultural One Zone (A1) is intended to accommodate agricultural and agri-tourism uses on lots that are 8.0 ha and larger in size. Permitted A1 Zone principal uses include:

- Agricultural Use;
- Agri-Tourism;
- Farm Retail Sales;
- Single Detached Dwelling; and
- Winery.

Agricultural and Resource Processing Zone (A3) is intended to accommodate agricultural, agri-tourism and limited resource processing uses with the following principle uses:

- Agricultural Use;
- Agri-Tourism;
- Farm Retail Sales;
- Resource Processing;
- Single Detached Dwelling; and
- Winery.

2.3 Surrounding Zoning and Land Use

Surrounding zoning is primarily Agricultural (A1) with Parks, Open Space and School Zone (P2) to the east and Recreation and Campground Commercial (CRC) use to the west. Except for 1010 Lefeuvre Road, all properties are located within the ALR. Current land use is a mixture of aggregate extraction, agricultural, institutional, and residential.

An inventory and description of the existing land use (BCMA, 2012) on surrounding properties and zoning is provided on Figure 2 and summarized in Table D.

Table D: Surrounding Land Use and Zoning

Civic Address	Zoning	Current Land Use
1461 Bradner Road	A3	Aggregate extraction
1505 Bradner Road	A1	Aggregate extraction, agricultural, residential
F, Plan 23316	A1	Unused
28776 King Road	P2	King Traditional Elementary school
28500 King Road	A1	Residential, Forage, Composting
28450 King Road	A1	Vineyard, Composting
28691 King Road	A1	Residential, agricultural
28571 King Road	A1	Residential, agricultural
1348 Lefeuvre Road	A1	Unused/forage, composting
Lot S12.5, NW1/4 Section 9, Township 13	CRC	Forage (corn)
1010 Lefeuvre Road	CRC	Forage (corn)
28215 Huntingdon Road	A1	Blueberry
28265 Huntingdon Road	A3	Stream/riparian, aggregate extraction
28473 Huntingdon Road	A1	Stream/riparian, forage, residential
1281 Bradner Road	A1	Stream/riparian, residential
1364 Bradner Road	A1	Trout farm, residential
1471 Bradner Road	A1	Residential
1481 Bradner Road	A1	Residential
1582 Bradner Road	A1	Poultry operation

3.0 SOILS

The Site, prior to extraction activities was historically mapped as a Columbia and Abbotsford series by Lutterding (1980) (Figure 3).

3.1 Soil Series

Typically, soils in the area are relatively young, having developed from glacial outwash and eolian deposits, which are rapidly drained. Prior to initiating extraction activities, overlying non-commercial soil was stripped and stockpiles onsite in nine locations. Stripped and stockpiled soil can be classified as Columbia and or Abbotsford soils.

3.1.1 Abbotsford

Abbotsford soils occur in the Fraser Valley mostly in the vicinity of Abbotsford, Clearbrook, Mission, and Hopington, as well as in the Columbia Valley south of Cultus Lake. Abbotsford soils typically occur on gently sloping to undulating slopes up to 5% but are also occasionally found in areas with strongly rolling slopes up to 25%. Elevations are predominantly between 20 and 100m above sea level but are found at elevations up to 200m in the Columbia Valley. Abbotsford soils develop from 20–50cm of coarse to medium-textured eolian deposits underlain by stratified gravelly glacial outwash. The surface and subsurface texture is mostly silty loam, varying sometimes to loam or fine sandy loam where the surface capping is thin. The underlying gravel and gravelly sand are usually stony and contain lenses of coarse and medium sand.

Abbotsford soils are well to rapidly drained and generally have 5cm or less of organic forest litter on the soil surface in their native state. This surface layer is underlain by a reddish-brown, silty, friable zone that becomes yellowish-brown or pale brown within 40cm. Below depths of 20–50cm there is usually a rapid change to loose, stratified gravel or gravelly sand. The Abbotsford soil is classified as ***Orthic Humo-Ferric Podzol***.

3.1.2 Columbia Soils

Columbia soils occupy substantial areas on the uplands of the Lower Fraser Valley. Columbia soils typically occur on usually level to gently undulating with gradients less than 5%, but are also found in scattered areas with strongly sloping or strongly rolling slopes to 20% and may rise to over 60% along terrace scarps. Columbia soils develop from deep, coarse-textured, stratified glaciofluvial deposits, typically with a thin (less than 0.2m thick), silty, eolian veneer mixed into or on the surface. Soil textures range from loam to gravelly loamy sand; however, sandy loam or gravelly sandy loam are most common. Subsurface textures are gravel or gravelly sand and contain some sand lenses. Stones and cobbles are common throughout.

Columbia soils are well to rapidly drained and generally have 5cm or less of organic forest litter on the soil surface in their native state. This is underlain by a thin (less than 2 cm), discontinuous, grayish, sandy, leached layer, which, in turn, is underlain by about 15 cm of sandy or loamy, friable, reddish-brown, brown, or yellowish-brown material. This material grades to about 40 cm of similarly coloured, loose gravel or gravelly sand. Below about 80 cm, unweathered, loose, stratified gravel and gravelly sand occur. The Columbia soil is classified as ***Orthic Humo-Ferric Podzol***.

3.2 Soil/Land Use Considerations

In addition to mapping soils within the Vancouver-Langley map area, historical soil surveys also identified issues that may impact land use, both for agricultural and development purposes based on the soil's physical and chemical characteristics (Luttmerding, 1981). Land use considerations for each soil series are summarized below. Limitations are primarily related to low water holding capacity and fertility associated with the Site's coarse textured soils.

3.2.1 Abbotsford

Abbotsford soils are well suited for most agricultural crops (root crops may be unsuited in areas where the silty capping is shallow). However, they tend to be droughty, and irrigation is usually required for good production in most years. The gravelly subsoil is usually a good source of aggregate.

3.2.2 Columbia

Agriculturally, Columbia soils are limited by low water holding capacity, relatively low fertility, and stoniness. With adequate fertilization and irrigation (and stone picking as required), most crops can be produced satisfactorily. They are well drained and have good bearing strength and level topography. Columbia soils are usually good sources of aggregate.

4.0 AGRICULTURAL CAPABILITY CLASSIFICATION

Land capability for agriculture in BC rates the capability of the land and climate to grow a wide range of crops. The scientifically-based process assesses limitations to agricultural production related to crop growth and management, and assigns a rating from 1 to 7 based on the number of limitations – with Class 1 soils having no limitations, and Class 7 soils having many limitations and no capability for agriculture. Table B summarizes the descriptions for each class.

The agricultural capability usually provides both an unimproved and improved rating. Unimproved ratings describe the land in its native condition without any improvements to the Site or soil, such as drainage and irrigation. Improved ratings indicate soil capability with appropriate management practices. Not all agricultural lands are similar, and not all agricultural lands are capable or suitable for producing all agricultural products, regardless of the level of management applied. Improvements typically implemented in BC include drainage systems, irrigation, stone picking, and soil amendments.

Typically, the ALC considers soils with Class 1 to 4 ratings as sites that are capable of agricultural production, although even soils that are not suitable for most crops may be highly suitable for a single crop, such as cranberries or grapes. The system also ranks Class 2 to Class 7 soils into capability sub-classes based on the types of limitations. Table C lists the common limitations, along with the improvement measures that are typically taken.

Agricultural capability has been rated for most sites in the ALR, but this was done at a very broad scale and many years ago, so for Site-specific applications, a detailed soil and capability assessment adds valuable decision-making information.

Table E: Land Capability Classes for Agriculture

Class	Description
Class 1	Land either has no or only very slight limitations that restrict its use for the production of common agricultural crops.
Class 2	Land has minor limitations that require good ongoing management practices or slightly restrict the range of crops, or both.
Class 3	Land has limitations that require moderately intensive management practices or moderately restrict the range of crops, or both.
Class 4	Land has limitations that require special management practices or severely restrict the range of crops, or both.
Class 5	Land has limitations that restrict its capability to producing perennial forage crops or other specially adapted crops.
Class 6	Land is non-arable but is capable of producing native and/or uncultivated perennial forage crops.
Class 7	Land in this class has no capability for arable or sustained natural grazing.

Table F: Limitations to Agriculture and Associated Improvements

Symbol	Limitation	Common Improvements
W	Excess water	Drainage systems
L	Permeability (organic soils)	Cannot be improved
D	Undesirable soil structure	Organic matter additions
N	Salinity	Difficult to improve. Improvement by drainage with regular flushing with non-saline irrigation
I	Inundation (by flooding)	Diking
A	Soil moisture deficiency I	Irrigation
P	Stoniness	Stone picking
F	Fertility	Fertilizer additions
T	Topography	Cannot be improved (except in exceptional circumstances)
R	Shallow depth to bedrock or bedrock outcrops	Cannot be improved

4.1 Historical Soil Survey

The majority of the Site has undergone significant modification due to historic and ongoing aggregate extraction activities. Historical surveys indicate the main agricultural limitations of the soils prior to extraction soil moisture deficiency and stoniness (Figure 3).

The existing less-detailed historical survey had mapped the area with:

- An unimproved rating of 70% 4AP[1] and 30% 3AP and an improved rating of 70% 3AP and 30% 2AP (MoAF and MoE 1983; map 92G1d).

[1] A – Soil moisture deficiency; P - stoniness

4.2 Current Soil Survey

A detailed soil survey has not been undertaken due to the widespread extraction activities and stockpiling of soil originating from onsite and offsite that have occurred across the Site. Interim capability ratings are not considered relevant as the entire Site will experience infilling and placement of a suitable topsoil cover as part of the planned reclamation activities.

5.0 STOCKPILED SOIL CHARACTERISTICS

Salvaged and imported soil is located in 18 stockpiles stored across the Site. Soil has originated from onsite sources which were stripped and stockpiled prior to extraction as well as offsite soils originating from several offsite sources located throughout the Lower Mainland. Origin and location of stockpiled soil is summarized in the following table:

Table G: Stockpiled Soil Location and Origin

Stockpile Location	Stockpile Origin	Source	Volume (m^3)
SP1	CP Soil	Imported	34,876
SP2	Nursery Loam	Imported	64,704
SP3	Area E Topsoil	Salvaged from site	7,667
SP4	PMH1 Spoil	Imported	831,579
SP5	Area C Soil	Salvaged from site	38,311
SP6	PMH1 Spoil	Imported	327,350
SP7	Nursery Loam	Imported	23,074
SP8	CP Soil	Imported	1,465
SP9	Topsoil	Salvaged from site	8,391
SP10	Soils	Salvaged from site	8,615
SP11	Area C Soil	Salvaged from site	6,273
SP12	Area E Soil	Salvaged from site	1,155
SP13	Area A Soil	Salvaged from site	34,488
SP14	Area A and B Soil	Salvaged from site	64,033
SP15	PMH1 Topsoil	Imported	50,134
SP16	Topsoil	Salvaged from site	8,500
SP17	Lafarge soil	Imported	18, 324
SP18	H99 and 16 Ave Soil	Imported	4,900

5.1 Soil Suitability Criteria

Golder previously assessed stockpile soil for physical characteristics and drain tile criteria. Chemical characteristics including fertility were not analysed as part of Golder's study. Criteria for physical characteristics are summarized in Tables H through I.

Evaluations of soil suitability are made by considering the interaction of various soil properties and characteristics to give an overall rating of the degree of suitability. Three categories of suitability and one category to indicate unsuitable areas are used.

The four categories are as follow:

1. **Good (G)** - None to slight soil limitations that affect use as a plant growth medium.
2. **Fair (F)** - Moderate soil limitations that affect use but which can be overcome by proper planning and good management.
3. **Poor (P)** - Severe soil limitations that make use questionable. This does not mean the soil cannot be used, but rather careful planning and very good management are required.
4. **Unsuitable (U)** - Chemical or physical properties of the soil are so severe reclamation would not be economically feasible or in some cases impossible.

Table H: Texture Criteria (from Table 7-1 of MoEMPR et al. 1995)

Criteria for Evaluating Suitability of Soil for Use in the Root Zone				
Rating/Property	Good (G)	Fair (F)	Poor (P)	Unsuitable (U)
Texture[A]	fSL, vfSL, L, SL, SiL	CL, SCL, SiCL	S, LS, SC, SiC, C, HC	
% Coarse Fragments (+2mm)	<30[1] <152	30 to 50[1] 15 to 30[2]	50 to 70[1] 30 to 50[2]	>70[1] >50[2]

[1] matrix texture for finer than sandy loam
[2] matrix texture sandy loam and coarser
[A]fSL = fine sandy loam; vfSL = very sandy loam; L = loam; SiL = silty loam; CL = clay; SCL = sandy clay loam; SiCL = silty clay loam; S = sand; LS – loamy sand; SC = sandy clay; SiC = silty clay; C = clay; C = heavy clay

Table I: Stoniness Criteria (Table 7-1 of MoEMPR et al. 1995)

Capability Class	Coarse Fragments[1]	Cobbles and Stones[2]	Comment
1	<5%	<0.01%	
2P (*1)	6 to 10%	0.01 to 1%	Class 1 tree fruit
3P (*2P)	11 to 20%	2 to 5%	Class 2 tree fruit
4P (*3P)	21 to 40%	6 to 15%[3]	Class 3 tree fruit
5P (*4P)	41 to 60%	16 to 30%	Class 3 tree fruit
6P	61 to 90%	31 to 80%	Class 7 presently not suitable for grazing

[1] fragments 2.5 cm diameter or larger
[2] fragments 7.5 cm diameter or larger
[3] included in adjusted *2P rating class 5
* adjustment rating for area climatically suited for growing tree fruits and grape, per: LCA for Agriculture (1983)

In addition to Golder's assessment of the physical characteristics of soil stockpiled on Site, PGL assessed the chemical characteristics of stockpiled soil. Criteria for physical and characteristics are summarized in Table J.

Table J: Criteria for Evaluating Suitability of Soil for Use in the Root Zone (from Table 7-1 of MoEMPR et al. 1995)

Criteria for Evaluating Suitability of Soil for Use in the Root Zone				
Rating/Property	Good (G)	Fair (F)	Poor (P)	Unsuitable (U)
Reaction (pH)[1]	> 5.0 to 7.5	4.0 to 5.0 & 7.6 to 8.4	3.5 to 4.0 & 8.5 to 9.0	< 3.5 and >9.0
Salinity (EC)[2] (dS/m)	< 2	2 to 4	4 to 8	> 8
Sodicity (SAR)[2]	< 4	4 to 8	8 to 12	> 12[3]
Saturation (%)[2]	30 to 60	20 to 30, 60 to 80	15 to 20, 80 to 120	< 15 and > 120
Organic Carbon (%)	2 to 17	1 to 2	< 1	> 17
$CaCO_3$ Equivalent	< 2	2 to 20	20 to 70	> 70

[1] pH values presented are most appropriate for trees, primarily conifers. Where reclamation objective is for other end land uses, such as erosion control, and where other plant species may be more important, refer to criteria for the Plains Region in Macyk et al. 1987.
[2] Limits may vary depending on plant species to be used.
[3] Materials characterized by an SAR of 12 to 20 may be rated as poor if texture is sandy loam or coarser and saturation % < 100.

5.2 Soil Suitability

5.2.1 Physical Characteristics

Golder's assessment determined that soil within the root zone should be a minimum of 0.5m above a 0.5m drain layer, which will provide adequate drainage.

Results of Golder's assessment are summarized in Table K. Based on the criteria established by MoEMPR et al. (1995), Golder made the following conclusions:

- 332,250m^3 from stockpiles SP6 and SP18 are suitable for root zone or drain layer;
- 87,778m^3 form stockpiles SP2 and SP7 are suitable for the drain layer;
- 1,036,853m^3 from stockpiles SP1, SP3 through SP5 and SP8 through SP14 are only suitable for bulk fill; and
- 79,958m^3 from stockpiles SP15 through SP17 were inaccessible and were not evaluated but should be tested when accessible to confirm suitability for root zone or drain layer.

Golder completed a second suitability assessment in which the coarse fragment greater than 25mm would be screened out prior to deposition. Results of this assessment are included in Table L and summarized below. In this scenario, 114,514m^3 of coarse fragments greater than 25mm would be screened from soil in stockpiles SP1 through SP14 and SP18. Resulting soil suitability would include:

- 329,217m^3 from stockpiles SP3, SP6, SP11, and SP18 are suitable for the root zone or drain layer;
- 1,013,150m^3 from stockpiles SP1, SP2, SP4, SP5, SP7 through SP10, and SP12 through SP14 are suitable for the drain layer; and
- 79,958m^3 from stockpiles SP15 through SP17 were inaccessible and were not evaluated but should be tested when accessible to confirm suitability for root zone or drain layer.

The most significant benefit of screening stockpiled soil would be an increase in soil suitable for the drain layer and reduction of soil that are only available for bulk fill.

Based on a review of the origin of SP2 and SP7 and feedback from MOTI, SP2 and SP7 are suitable for use as subsoil, and while it does not meet the criteria for good or fair topsoil, management of texture through addition and blending of other suitable soil may make the soil an acceptable topsoil.

Table K: Suitability of Tested Stockpiles for Reclamation for physical characteristics (from Golder (2016))

Site	Comment	Volume (m^3)	Suitability						Suitable for Root Zone or Drain Layer (m^3)	Suitable for Drain Layer (m^3)	Suitable for Fill only (m^3)
			Textural Class Suitability Rating	Coarse Fragment (>2mm) Suitability Rating	Overall LCA Class (unimproved)	Overall LCA Class (improved)	% >2"	% from 1" to 2"			
SP1	CP soil	34,876	P	U	5A	3A	1.9	13.2	-	-	34,876
SP2	nursery loam	64,704	P	F	4A	3A	0	5.2	-	64,704	-
SP3	Area E topsoil	7,667	G	P	4AP	3A	10.4	7.9	-	-	7,667
SP4	PMH1 spoil	831,579	G	P	4AP	3A	1.5	3.2	-	-	831,579
SP5	Area C spoil	38,311	P	P/U	4AP	3A	13.8	9.2	-	-	38,311
SP6	PMH1 spoil	327,350	G	G/F	3AP	2A	1.1	3.4	327,350	-	-
SP7	nursery loam	23,074	P	G/F	4A	3A	0	0.5	-	23,074	-
SP8	CP soil	1,465	G	U	5AP	3A	6.1	17	-	-	1,465
SP9	topsoil	8,391	P	F	4A	3A	6.7	3	-	-	8,391
SP10	soils	8,615	G	U	4AP	3A	26.7	6.8	-	-	8,615
SP11	Area C soils	6,273	G	F	4A	3A	4.8	2.7	-	-	6,273
SP12	Area E soils	1,155	P	F	4AP	4A	9.6	2.7	-	-	1,155
SP13	Area A soils	34,488	G	P	4AP	3A	1.1	10.4	-	-	34,488
SP14	Area A and B soil	64,033	G	P/U	4AP	3A	4.8	9	-	-	64,033
SP18	H99 and 16 Ave soils	4,900	G	F / P	4A	3A	0	2.1	4,900	-	-
TOTAL		**1,456,881**	-	-	-	-	-	-	**332,250**	**87,778**	**1,036,853**
SP15	PMH1 topsoil	50,134	Not tested						-	-	50,134
SP16	topsoil	8,500							-	-	8,500
SP17	Lafarge soils	18,324							-	-	18,324
GRAND TOTAL		**1,533,839**	-	-	-	-	-	-	**332,250**	**87,778**	**1,113,811**

G and F denote suitable soils
P and U denote not suitable soils

*

Table L: Suitability of Tested Stockpiles for Reclamation with Screening of 25 mm material (from Golder (2016))

Site	Comment	Volume (m^3)	Volume after screening (m^3)	Suitability						Suitability as Root Zone Layer (m^3)	Suitability as Drain Layer (m^3)
				Textural Class Suitability Rating	Coarse Fragment (>2mm) Suitability Rating	Overall LCA Class (unimproved)	Overall LCA Class (improved)	% >2"	% from 1" to 2"		
SP1	CP soil	34,876	29,596	P	U	3A	2A	0	0	-	29,596
SP2	nursery loam	64,704	61,354	P	F	3A	2A	0	0	61,354*	-
SP3	Area E topsoil	7,667	6,269	G	F	3A	2A	0	0	6,269	-
SP4	PMH1 spoil	831,579	775,887	G	P	3A	2A	0	0	-	775,887
SP5	Area C spoil	38,311	25,678	P	P	3A	2A	0	0	-	25,678
SP6	PMH1 spoil	327,350	312,350	G	G	1	1	0	0	312,350	-
SP7	nursery loam	23,074	22,959	P	G	3A	2A	0	0	22,959*	-
SP8	CP soil	1,465	1,098	G	P	3A	2A	0	0	-	1,098
SP9	topsoil	8,391	7,574	P	G/F	3A	2A	0	0	-	7,574
SP10	soils	8,615	5,727	G	P	3A	2A	0	0	-	5,727
SP11	Area C soils	6,273	5,800	G	F	3A	2A	0	0	5,800	-
SP12	Area E soils	1,155	1,014	P	G	4A	3A	0	0	-	1,014
SP13	Area A soils	34,488	27,068	G	P	3A	2A	0	0	-	27,068
SP14	Area A and B soil	64,033	55,196	G	P	3A	2A	0	0	-	55,196
SP18	H99 and 16 Ave soils	4,900	4,797	G	F	3A	2A	0	0	4,797	-
	TOTAL	**1,456,881**	**1,342,367**	-	-	-	-	-	-	**413,529**	**928,838**
SP15	PMH1 topsoil	50,134	-	Not tested						-	50,134
SP16	topsoil	8,500	-							-	8,500
SP17	Lafarge soils	18,324	-							-	18,324
	GRAND TOTAL	**1,533,839**	-	-	-	-	-	-	-	**413,529**	**1,005,796**

* Suitable for subsoil as is or topsoil if texture can be improved

G and F denote suitable soils
P and U denote not suitable soils

5.2.2 Chemical Characteristics

The MOTI retained Hemmera Envirochem Inc. (Hemmera) in 2020 to re-evaluate soil stockpile elevations presented in the 2019 Strong Pit Soil and Groundwater Investigation report. As part of the assessment, the sample source populations previously used for statistical analysis of SP4, SP6, and native soil were revised per the BC ENV Technical Guidance on Contaminated Sites 2: Statistical Criteria for Characterizing a Volume of Contaminated Material (2009).

Based on their statistical analysis, Hemmera (2020) determined that arsenic, chromium, and iron in SP4 meet CSR standards for agricultural land use (AL). Chloride, benzo(b,j) fluoranthene, indeno (1,2,3-c,d) pyrene, phenanthrene, and pyrene; however, exceed the AL standards but meet commercial land use standards. Therefore, SP4 is not considered suitable for agricultural use and must be buried a minimum of 3m below grade.

PGL's soil fertility assessment included collection of soil samples from stockpiles previously identified as topsoil and having suitable soil texture (SP3, SP6, SP11, SP15 and SP17). Stockpiled soil not meeting the textural suitability rating were excluded in the assessment of chemical characteristics and fertility as the soil will be used for bulk fill or the drain layer and not used within the root zone.

Results of PGL's assessment are summarized in Tables M and N. Based on the criteria established by MoEMPR et al. (1995) and industry recommendations.

Suitability ratings for pH, electric conductivity (EC) or organic matter content were generally good to fair with only a couple instances of poor, which can be managed through accepted soil management practices. All samples were found to have deficient levels of nitrogen and micronutrient concentrations of zinc, boron and chloride were found to be deficient in almost all samples. Deficient concentrations of phosphorus, potassium, sulphate, magnesium and/or manganese were observed in one or more samples while excessive concentrations of calcium were observed in four samples. Macro- and micro-nutrient deficiencies can affect soil fertility and plant growth while excess calcium can affect ion balance within plants, affecting potassium and magnesium levels.

The variability in nutrient concentrations is expected based on the variety of sites which the soils were sourced from. Nutrient deficiencies can be addressed through a nutrient management regime specific to the limitations identified during PGL's assessment following soil placement. Efforts should be undertaken to conserve all sampled stockpiles soils identified as topsoil (SP3, SP6, SP11, SP15 and SP17) and prioritize their use for topsoil during site restoration. These soils should not be buried at depth.

Table M: Suitability of Tested Stockpiles for Reclamation for Chemical Characteristics

Site	Comment	Sample	Volume (m^3)	Volume after screening (m^3)	Suitability		
					pH	EC (dS/m)	OM (%)
SP3	Area E topsoil	SP3-1-1	7,667	6,269	5.8	0.2	2.9
		SP3-2-1			7	0.26	0.8
SP6	PMH1 spoil	SP6-1-1	312,350	312,350	7.4	0.2	1.4
		SP6-1-2			7.8	0.82	1.2
		SP6-2-1			7.7	0.08	<0.1
		SP6-2-2			7	0.21	1.3
		SP6-2-3			7	0.2	1.9
		SP6-3-1			8.3	0.26	1.2
		SP6-3-2			8.5	0.35	1.8
SP11	Area C soils	SP11-1	6,273	5,800	6.3	0.2	3.7
		SP11-2			6.5	0.09	4.1
SP15	PMH1 topsoil	SP15-1-1	50,134	-	6.2	0.1	5.4
		SP15-1-2			7.1	0.2	4.9
		SP15-2-1			7.7	0.07	1.2
		SP15-2-2			8.2	0.44	1.6
SP17	Lafarge soils	SP17-1-1	18,324	-	6.8	0.07	1.9
		SP17-1-2			6.7	0.06	1.5

G and F denote suitable soils
P and U denote not suitable soils

Macro- and micro-nutrient concentrations required to produce excellent and average growing conditions for field crops based on current individual stockpile nutrient concentrations as determined by Element laboratory are included in Appendix 2. Recommended nutrient additional are provided on a lb/acre basis for hay and alfalfa. Nutrient requirements will vary based on crop selection.

Table N: Suitability of Tested Stockpiles for Reclamation for Soil Nutrient Concentrations

Site	Comment	Sample	Volume (m^3)	Volume after screening (m^3)	Nutrients (ppm)											
					N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl
SP3	Area E topsoil	SP3-1-1	7,667	6,269	<2	34	56	4	265	21	64.4	0.8	<0.5	0.1	2.5	6.2
		SP3-2-1			<2	35	31	3	486	9	13.7	0.5	<0.5	<0.1	0.8	1
SP6	PMH1 spoil	SP6-1-1	312,350	312,350	<2	29	49	18	971	136	45.2	1.8	<0.5	<0.1	5	2
		SP6-1-2			<2	28	120	166	3440	143	100	2.3	<0.5	0.3	24.5	22
		SP6-2-1			<2	9	44	4	502	53	19.6	1	<0.5	<0.1	2.9	2
		SP6-2-2			<2	31	84	15	1310	122	115	2	<0.5	0.1	128	1
		SP6-2-3			4	37	85	14	1040	138	153	3.5	1	0.2	48.3	3
		SP6-3-1			<2	27	91	13	3210	76	50.3	2.7	0.7	0.2	6.6	0.9
		SP6-3-2			<2	25	128	30	3960	69	89.2	3.2	1	0.2	25.3	12
SP11	Area C soils	SP11-1	6,273	5,800	10	>80	167	6	796	69	86.9	1.5	4.2	0.8	5.8	1
		SP11-2			4	>80	114	3	718	45	105	1.5	3.4	0.7	3.6	1
SP15	PMH1 topsoil	SP15-1-1	50,134	-	5	17	57	4	575	76	71.6	3	0.6	0.2	5.9	0.8
		SP15-1-2			<2	20	82	5	925	85	290	2.5	0.6	0.2	129	30
		SP15-2-1			<2	35	67	3	753	89	41.2	1.2	<0.5	<0.1	5.6	8.3
		SP15-2-2			<2	26	111	60	4270	50	100	2.6	1	0.2	34.3	6.6
SP17	Lafarge soils	SP17-1-1	18,324	-	<2	68	80	2	384	44	89.3	0.9	<0.5	0.1	35.9	1
		SP17-1-2			<2	63	78	3	320	28	134	1	<0.5	0.1	66.4	4

*Nitrate-N
** Sulfate-S
denote suitable soils (marginal or optimum concentrations)
denote not suitable soils (excess or deficient concentrations)

6.0 RECLAMATION PLAN

The reclamation plan has been developed to provide best management practices for aggregate extraction for land located within the ALR and to meet ALC recommendations as outlined in the ALC's 2021 Reclamation Plans for Aggregate Extraction (Policy P-13). The reclamation plan and best management practices include the following which are discussed in the following sections:

- Soil management techniques;
- Recontouring and subgrade preparation;
- Soil placement (Topsoil/Subsoil);
- Seedbed preparation and surface rehabilitation;
- Drainage and water management;
- Weed management; and
- Project closure.

The end land use is agricultural; therefore, reclamation will focus on restoring gentle landforms, establishing equivalent drainage, and reconstructing an acceptable soil. As the Site is in an area of high-quality farmland, the land will be returned to an equivalent agricultural capability and achieve a final site condition that is similar to pre-extraction land capability, Class 2 or better.

6.1 Soil Management

During restoration, portions of the Site not previously disturbed or areas that were previously reclaimed may require soil stripping. To conserve the topsoil from the affected areas which would otherwise be lost, topsoil must be salvaged and stored onsite in either a soil stockpile or windrow for future placement.

As the upper part of the soil profile is richest in organic matter and most valuable for agricultural purposes, the topsoil will be separated from any additional overburden which the contractors require to be removed. To ensure that soil is properly segregated, the qualified registered professional will be required to be present during all soil salvaging activities to direct removal of the topsoil.

Only the organic enriched (dark coloured) topsoil will be salvaged. If the topsoil is thinner, less material will be stripped. The lighter coloured mineral horizon located beneath the topsoil will not be mixed with the topsoil. Topsoil will not be stripped during overly dry, wet, or windy conditions.

Prior to any additional extraction, all existing topsoil must be salvaged under the direction of the qualified registered professional for use during reclamation. Additional salvaging of subsoil and overburden may be necessary on sites where backfill sourced from offsite is not readily available, topsoil is shallow or where there is limited overburden available. The recommendations for soil handling procedures must proceed following the ALC's 2021 Reclamation Plans for Aggregate Extraction which includes:

- Soil must be salvaged from all of the following areas:
  - The proposed pit or quarry area;
  - The access roads; and
  - The proposed stockpile areas for the subsoil and overburden.
- Topsoil, subsoil, and any overburden must be salvaged and stored separately;

  - Separation between piles should be no less than 3m.
- Topsoil must be salvaged using an excavator with a clean-out bucket;
- Materials must be transported to an appropriately designated storage area that will not be disturbed by extraction activities in order to avoid double handling of materials;
- A uniform layer of bark mulch or sawdust should be laid down on the storage surface prior to placement of any salvaged material;
- The areas required for stockpile storage must be based on estimates of initial soil salvaging volumes;
- Stockpiled soils must be windrowed and located in an area where they will not be disturbed and will not impede site drainage;
- Drainage from, onto and around the stockpiles must be controlled by ditches, drains or intercepts as required;
- Stockpiled soil must not be removed from the property without written permission from the Commission;
- Salvage piles should be limited in height (2 to 3 meters). Higher piles must not exceed a 3H:1V slope (horizontal: vertical); and
- Stockpiles must be seeded and established with an appropriate plant cover or other suitable soil erosion control measure must be applied to protect the stockpiles from wind or water erosion.

6.2 Subgrade Preparation

Backfilling of the pits is required to ensure that the final elevation is consistent with adjacent land and the planned final reclamation profile. Following completion of extraction activities, the pit should be filled with suitable material that consists of the stockpiled overburden and/or fill sourced from offsite.

Preparation of the subgrade must proceed following the ALC's 2021 Reclamation Plans for Aggregate Extraction which includes:

- Imported fill used to backfill must have the following characteristics:
  - Must be of mineral origin only (organic soils are not permitted as fill material but can be used as a top-dress);
  - Have a coarse fragment content less than 5% with no boulders >25cm in the top 1m of the soil profile; and
  - The texture of the soil must be no coarser than loamy sand and no finer than silt loam.
- The following are prohibited materials in the ALR and must not be used as fill:
  - Concrete or demolition waste, including masonry rubble, concrete, cement, rebar, drywall, and wood waste;
  - Asphalt;
  - Glass;
  - Synthetic polymer;
  - Treated wood; and
  - Unchipped lumber.
- The final contours of the subgrade must be gently sloping in such a manner as to conform to the surrounding landscape;
- Depending on the Site topography, any permitted side slopes and/or benches should be recontoured so that slopes are no steeper than 3.5H:1V (horizontal:vertical) to allow for use of farm equipment on the slopes. Use of steeper slopes in order to maximize the amount of flat land (e.g., long narrow extraction pits) is not expected.

- To avoid severe erosion of topsoil, land that is intended for the production of annual crops should have slopes no greater than 20H:1V or 5% slope (Class 1);
- As the Site is located within the Lower Fraser Valley, the slopes must be less than 1% on cropland to minimize sheet and rill erosion; and
- If necessary, upon completion of backfilling, the subgrade should be chisel ploughed to a minimum depth of 60cm in two directions at right angles.

6.3 Soil Replacement

Once the subgrade materials have been regraded, available topsoil and/or other suitable soil materials must be used to provide a rooting bed for crops. Before replacing topsoil, erosion and sedimentation control structures will be used as necessary to minimize soil loss.

Prior to replacement of stockpiled soil, steps will be taken to prepare the surface of the receiving site, including re-contouring to provide positive drainage that blends into the surroundings and applying the rough and loose treatment to the surface layer to increase infiltration and deter unwanted access. Roughening will be completed immediately prior to spreading the topsoil. The subgrade will be loosened by discing or scarifying to a depth of at least 100mm to ensure bonding of the topsoil to the existing surface soil. Topsoil will not be spread if frozen or muddy.

Following replacement, topsoil will be compacted enough to ensure good contact with the underlying soil, while avoiding excessive compaction which would increase runoff and inhibit seed germination. On slopes and areas that will not be mowed, the surface may be left rough after spreading topsoil.

Soil replacement should follow the ALC's 2021 Reclamation Plans for Aggregate Extraction which includes the following recommendations:

6.3.1 General Recommendations

- Any stockpiled soils must be replaced in the reverse order from which they were removed.
- The recommended soil profile should consist of (from surface to at depth):
  - 20–30cm of topsoil;
  - 30cm of subsoil;
  - 50cm of free draining subgrade; and
  - Overburden or backfill (variable thickness to an elevation of 100cm or more below final grade)
- The placement of stakes, flagged to the desired replacement thickness, must be employed to assist the machine operator.
- Soil materials should be end dumped and levelled with low ground pressure equipment, such as tracked bulldozers.
- Vehicles and equipment must be restricted to designated roads or routes, so that ripping and subsoiling activities can be limited to these specific areas.
- Random, repeated running of equipment over levelled areas must be minimized wherever possible.

6.3.2 Subsoil Placement

- If subsoil has been retained, the subsoil must be replaced in one lift;
- If fill is used as subsoil, then the fill must have a coarse fragment (fragments >2mm diameter) content of less than 5% and must not contain any boulders (rock fragments >25cm);
- Once the subsoil is in place, roughening the subsoil surface is required to hold topsoil in place following initial placement; and
- If compaction does occur, rip the affected areas to a depth of 60cm or more with shanks spaced 60cm apart and then cross rip perpendicular to the first direction.

6.3.3 Topsoil Placement

- Topsoil thickness should be equivalent to what was present before.
- Coarse fragments must not be introduced in the top 25cm of the soil profile.
- Prior to replacement of the topsoil, soils must be screened separately to remove coarse fragments.
- Where the percentage of the coarse fragment content by volume is less than 5%, screening is not necessary. The qualified registered professional must determine if screening is necessary.
- Screening must be carried out under appropriate soil moisture conditions.
- Topsoil should not be replaced in areas such as roads or wet depressions that will not be used for productive agriculture unless required for grass establishment for erosion control.
- If the native topsoil has been removed, then a 20–30cm lift of imported topsoil must be uniformly spread over the disturbance area. The texture of the soil must be no coarser than loamy sand or finer than silt loam.
- A suitable organic matter should be top-dressed over the reclamation area. This organic matter may be added in the form of animal or poultry manure or as a cereal or forage cover crop and turned into the soil.

6.4 Final Slope

Slope gradient, length and complexity affect the agricultural capability of farmland and affect the potential for soil erosion, with an increase in slope adversely affecting the lands agricultural capability. Increased slope complexity also has the potential to affect soil drainage, potentially leading to ponding. Slope gradient limitations are summarized in Table O, with Class 1 soils occurring on simple slopes between 0 and 5%.

Table O: Land Capability Classes and Slope Gradients (from Table 7-2 of MoEMPR et al. 1995)

Class Rating	Simple Slopes (%)	Complex Slopes (%)
1	0 to 5	0 to 2
2T	6 to 10	3 to 5
3T	11 to 15	6 to 10
4T	16 to 20	11 to 15
5T	21 to 30	16 to 30
6T	31 to 60	31 to 60
7T	31 and over **	31 and over**

** Lands in their present for do not sustain natural grazing

The agrologist for 28450 and 28500 King Road (Fraser Valley Aggregates), C&F Land Resource Consultants Ltd. has developed a conceptual grading plan as part of the reclamation plan for the properties located immediately west of 1505 Bradner Road. The reclamation plan proposes an elevation of approximately 101.4m along the southern edge, which slopes down to 99.0m along the northern edge of the property, providing a slope of 1%, directing surface flow to the north to an infiltration bed. To maximize the area available to agriculture, the Strong Pit reclamation plan has included scenarios in which Fraser Valley Aggregates (FVA) remediation plan has been taken into consideration. FVA's reclamation plan also considered reconfiguration of the two Strong Pit lots, however this has not been included in our reclamation plan.

The reclamation plan proposes a reclaimed elevation of 99m ASL along King Road, tying into the surrounding elevation. PGL has prepared final surfaces for the following scenarios:

1. Strong Pit – FVA Conceptual Grading Scenario; and
2. Strong Pit Conceptual Grading Scenario.

Conceptual figures and cross-sections are provided in Figures 5 and 6. All scenarios include retention of the detention ponds currently located along the southern portion of 1461 Bradner Road.

6.4.1 Strong Pit – FVA Conceptual Grading Scenario

Strong Pit – FVA Conceptual Grading Scenario 1 includes development of the Strong Pit grading plan with consideration for the proposed FVA reclamation plan. This scenario also considers reclamation of both Strong Pit parcels occurring concurrently.

Under Strong Pit – FVA Scenario the elevation will increase from 99.0m above sea level (ASL) along King Road to the south at a rate of 1% to a maximum elevation of 101.4m until a crest at which point the slope will decrease to the south.

6.4.2 Strong Pit Conceptual Grading Scenario

The Strong Pit Conceptual Grading Scenario does not take into consideration the proposed FVA reclamation plan or their proposed final elevations. The scenario also considers reclamation of both Strong Pit parcels occurring concurrently. Under this scenario the maximum elevation would be 99.0m ASL and occur along the northern edge of 1505 Bradner Road and slope downward to the south.

6.5 Soil Volumes

Soil requirements to meet the various grading scenarios are summarized in Table P and detailed breakdowns for topsoil, subsoil, free draining subgrade, and overburden are provided in Tables Q through T.

Table P: Soil Volume Requirements for Conceptual Grading Scenarios

	No Screening		With Screening	
	Strong Pit – FVA Conceptual Grading Scenario	Strong Pit Conceptual Grading Scenario	Strong Pit – FVA Conceptual Grading Scenario	Strong Pit Conceptual Grading Scenario
Total Required Material	2,058,886m^3	1,817,237m^3	2,058,886m^3	1,817,237m^3
Available Material	1,533,839m^3	1,533,839m^3	1,419,325m^3	1,419,325m^3
Outstanding Material Required	525,047m^3	283,398m^3	639,561m^3	397,912m^3

Table Q: Soil Balance Requirements for Strong Pit – FVA Conceptual Grading Scenario without Screening

	Required	Available	Balance
Topsoil (0.3m thick)	137,985m^3	420,028m^3	-85,917m^3
Subsoil (0.3m thick)	137,985m^3		
Free Draining Subgrade (0.5m)	229,975m^3		
Overburden	1,552,941m^3	1,113,811m^3	-439,130m^3
Total	**2,058,886m^3**	**1,533,839m^3**	**-525,047m^3**

* Positive balance values imply excess material; negative balance values imply deficit

Table R: Soil Balance Requirements for Strong Pit Conceptual Grading Scenario without Screening

	Required	Available	Balance
Topsoil (0.3m thick)	137,985m^3	420,028m^3	-85,917m^3
Subsoil (0.3m thick)	137,985m^3		
Free Draining Subgrade (0.5m)	229,975m^3		
Overburden	1,311,292m^3	1,113,811m^3	-197,481m^3
Total	**1,817,237m^3**	**1,533,839m^3**	**-283,398m^3**

* Positive balance values imply excess material; negative balance values imply deficit

Table S: Soil Balance Requirements for Strong Pit – FVA Conceptual Grading Scenario following Screening

	Required	Available	Balance
Topsoil (0.3m thick)	137,985m^3	413,529m^3	275,544m^3
Subsoil (0.3m thick)	137,985m^3		
Free Draining Subgrade (0.5m)	229,975m^3	1,005,796m^3	777,120m^3
Overburden	1,552,941m^3		
Total	**2,058,886m^3**	**1,419,325m^3**	**-639,561m^3**

* Positive balance values imply excess material; negative balance values imply deficit

Table T: Soil Balance Requirements for Strong Pit Conceptual Grading Scenario following Screening

	Required	Available	Balance
Topsoil (0.3m thick)	137,985m^3	413,529m^3	-275,544m^3
Subsoil (0.3m thick)	137,985m^3		
Free Draining Subgrade (0.5m)	229,975m^3	1,005,796m^3	-777,120m^3
Overburden	1,311,292m^3		
Total	**1,817,237m^3**	**1,419,325m^3**	**-397,912m^3**

* Positive balance values imply excess material; negative balance values imply deficit

6.6 Drainage/Water Management

Reclamation of the Site for agricultural purposes will require adequate site (removal of surface water) and soil drainage (removal of excess water from the rooting zone). Site drainage is currently via infiltration or collection in existing Site drainage ditches and sediment ponds located in the southwest corner of the Site.

Re-establishment of Site drainage will:

- Prevent erosion from uncontrolled overland flow;
- Control flooding and ponding on site and adjacent areas; and
- Minimize obstacles for farm equipment resulting from gullies and wet depressions.

The following drainage and erosion control measures should be considered when designing the plan; however, this will vary depending on specific site conditions:

- Interceptor drains and grassed water runs to slow the velocity of runoff water and prevent erosion;
- Placement of toe slope drains to collect and remove seepage from the subsoil;
- Use of temporary diversion drainage on new areas of topsoil and seeded areas;
- Sedimentation impoundments to protect water quality in downstream areas. The size and location of impoundments will be determined by runoff volumes, erosion rates, and required retention times;
- Installation of a soil drainage system (subsurface drainage as needed). This will depend on the end use and agronomic needs;
- Installation of a layer of porous drainage material to reduce the amount of water in the soil; and
- The drainage must be installed upon completion of rehabilitation of each phase and prior to establishing any perennial crops other than forage.

The reclaimed area must be monitored by the qualified professional following re-seeding to determine if sufficient drainage has been provided. If poorly drained areas persist, it may be necessary to install additional drainage structures.

6.7 Post-Reclamation Agricultural Capability

Most of the Site has undergone significant modification due to historic and ongoing aggregate extraction activities. Historical surveys indicate the main agricultural limitations of the soils prior to extraction soil moisture deficiency and stoniness. The existing historical survey had mapped the area with an unimproved rating of 70% 4AP and 30% 3AP and an improved rating of 70% 3AP and 30% 2AP (MoAF and MoE 1983; map 92G1d).

Following extraction activities, the current agricultural capabilities of the Site have been reduced across most of the Site. Moisture deficiencies continue to be a primary limitation as well as stoniness and nutrient deficiencies in mined portions of the Site and topographic and nutrient deficiencies in portions of the site where soil originating from offsite sources were stockpiled.

Post reclamation agricultural capability will be Class 2 or better across most of the Site with the exception of side slopes which will have topographic limitations and the retained sedimentation ponds.

7.0 SEEDBED PREPARATION/SURFACE REHABILITATION

Following fill deposition, the filled areas will be seeded with an appropriate agronomic species (i.e., a grass/legume mixture) and fertilized if the disturbance area is not immediately returned to agricultural use upon completion to avoid weed intrusion and reduce erosion on slopes. Additional planting will be based on the future agricultural activities occurring onsite.

Seed preparation and surface rehabilitation will follow the ALC's 2021 Reclamation Plans for Aggregate Extraction as follows:

- Till the seed bed just prior to seeding to minimize the time period in which the soil surface will be exposed to water and wind erosion;
- Tillage must be completed only under specific soil moisture conditions (not powdery dry or excessively wet);
- The following equipment is suitable depending on the specific soil conditions:
  - Tillage equipment – plows and discs that lift and invert the soil;
  - Cultivators and harrows that lift and stir without inverting the soil; and,
  - In situations where it is undesirable to mix thin topsoil with underlying subsoil (e.g., stony subsoil) use cultivators and harrows rather than plows and deep discs.
- Soil tillage should be carried out across (perpendicular to) slopes to reduce the runoff velocity and the potential for rill formation;
- The rate of application, type of seed mix, and fertilizer is to be determined by the qualified registered professional;
- Cereal cover crops such as spring barley, oats, winter wheat or fall rye germinate and develop rapidly. If seeded in mid to late summer, they provide cover by fall but will not generally set seed and will not take over the stand the following year if turned over before seed set;
- Fertilizer should be applied based on soil testing results; and
- Use supplementary irrigation to establish and maintain a complete cover.

7.1 Crop Selection

Suitable crops identified for the soils identified across the Site include a very wide range of crops[2]. Climatically adapted crops have been placed into one of three groups depending on the level of management required to achieve an acceptable level of production:

- **Well-suited Crops** – a low to moderate level of management inputs are required to achieve an acceptable level of production;
- **Suited Crops** – a moderate to high level of management inputs are required to achieve an acceptable level of production; and
- **Unsuited Crops** – the crops are not suited to the particular soil management group.

Well-suited, suited, and unsuited crops for each soil series are summarized below.

Table U: Suited Crops for Strong Pit Following Reclamation

Soil Series	Well Suited Crops	Suited Crops	Unsuited Crops
Abbotsford	All climatically suited crops where surface soil >50cm	All climatically suited crops where surface soil <50cm	None
Columbia	None	Annual legumes, blueberries, cereals, corn, nursery and Christmas trees perennial forage crops, raspberries, strawberries, and tree fruits	Cole crops, root crops and shallow-rooted annual vegetables where soils are stony

7.2 Weed Management

Listed noxious weeds (also referenced as invasive plants) must be controlled as required under the *Weed Control Regulation B.C. Reg. 66/85* and/or Section 15 of the *Environmental Protection and Management Regulation* B.C. Reg 200/2010. Efforts will be taken to focus on the identification and prevention of introduction, establishment, and spread of invasive plants during use of the receiving areas. Measures intended to prevent the introduction of invasive plant species during the construction phase of the Project may include the following:

- Avoiding unloading, parking, or storing equipment and vehicles in invaded areas;
- Ensuring that all construction equipment and machinery entering the site is clean and clear of non-native soils and invasive plants or plant parts; and
- Ensuring all seed entering the site for reclamation purposes is approved and sourced from a supplier that guarantees delivery of invasive plant-free products.

[2] Bertrand, R.A., Hughes-Games, G.A. and Nikkel, D.C. 1991. Soil Management Handbook for the Lower Fraser Valley. BC Ministry of Agriculture, Fisheries and Food.

Weeds must be controlled before seed set. The most common practices include:

- Cultural methods such as reseeding with an appropriate vegetative mix that can out-compete weeds;
- Mechanical methods such as tillage, mowing, mulching or use of black plastic sheeting; and
- Chemical methods such as the use of herbicides.

All newly reclaimed areas must be reseeded as soon as possible after soil replacement.

8.0 RECLAMATION MANAGEMENT

The reclamation plan has been developed to minimize the impacts to agriculture and surrounding land use and produce a significant improvement to the Site's agricultural capability.

8.1 Fill Monitoring Plan and Fill Certification

All material brought to the Site will be monitored by accompanying documentation from its place of origin to ensure that no potential environmental risks are associated with the material. This typically requires completion of a Phase 1 Environmental Site Investigation which assesses current and historical land uses on the site and surrounding properties, and identifies any potential activities of environmental concern.

Fill must not include any of the following, which are defined as Prohibited Fill in the ALR Use Regulation:

a) Construction or demolition waste, including masonry rubble, concrete, cement, rebar, drywall, and wood waste;
b) Asphalt;
c) Glass;
d) Synthetic polymers (e.g., plastic drainage pipe);
e) Treated wood; and
f) Unchipped lumber.

To ensure that the soil meets the intended purpose of improving the Site's agricultural capability, a Professional Agrologist will conduct regular Site visits following the start of the project to confirm that fill has been placed as described in the reclamation plan.

A final report will be submitted to MOTI upon completion of the project. The final report will include, but is not limited to:

- A written description of the project;
- Evidence that the fill placement project has been completed as described in the reclamation plan;
- Final cross-section profiles of the fill project area showing final contours;
- Clear and accurate measurements of the fill project area, depths, and volumes of imported fill;
- Photographs of the project area accompanied by a scale drawing; and
- A hydrological overview with respect to drainage of the project area.

8.2 Erosion Control

Erosion control measures will be required during fill deposition, as well as during agricultural operation. The main objective of the erosion and sediment control (ESC) measures during fill deposition will be to prevent sediment discharges to Site watercourses/drainage ditches, thereby ensuring that runoff does not exceed applicable suspended solid levels. The ESC measures will be in place before the start of work at the Site. The ESC plan will also be prepared top ensure that peat extraction and fill deposition activities do not adversely impact surface or groundwater quality.

The basic ESC measures for the Site may include:

- Meeting regulatory requirements for total suspended solids of discharge water;
- Installing silt fencing along the edges of all watercourses/ditches;
- Installing silt fencing along the bases of all fill slopes;
- Covering fill slopes with polyethylene sheeting or mulch, or having them hydroseeded if they are present for the long term; and
- Having the ESC measures inspected on a regular basis and before/after significant rainfall events.

During fill deposition, the Site operator will modify and/or halt activity during periods of excessively heavy precipitation when the potential for erosion is unacceptably high.

Once the fill deposition has been completed and slopes have been established, the following general soil management strategies will be implemented to control water erosion:

- Runoff water will be controlled to prevent erosion of surface soils;
- Vegetation cover will be maintained to prevent mobilization of surface soil and to allow better infiltration of water; and
- Soil structure with good internal drainage will be maintained to permit infiltration.

8.3 Drainage Control

All proposed reclaimed surface options include establishing minimum slope of 1% following the completion of fill deposition. This will also result in a low erosion hazard (Bertrand et al. 1991) and while minimizing the potential for surface ponding. Soils will be medium to coarse-grained with some fines, which will provide good infiltration and internal drainage during high-rainfall periods. Water will flow due to Site grading via both overland and internal flow. Surface water will be directed to ditches to the north of the site as well as the southwest corner of the Site to the existing drainage ponds which will provide sediment control and facilitate infiltration.

8.4 Buffer

The Site is within an agricultural zoned area of Abbotsford. Site fill deposition activities and reclamation have the potential to impact adjacent properties through changes in visual quality, as well as noise and dust generation during fill and re-contouring activities. Existing natural buffering and management programs are expected to minimize or offset any residual impacts. Existing buffers include:

- North: Residential and agricultural property;

- West: Agricultural and aggregate extraction;
- South: Agricultural; and
- East: Elementary school.

Management programs for noise and dust are described below.

8.5 Noise Control

Heavy equipment, including earth moving equipment and trucks, will be required for the proposed fill deposition activities. The expected impact of noise is considered to be minimal given the location of the Site and surrounding land use. The Site is in the City of Abbotsford within a larger area of agricultural land use, with no significant residential use.

Although no sensitive receptors exist adjacent to or immediately near the Site, the property owner intends to incorporate mitigation options and a noise management program to minimize noise effects:

- Operating hours will be in accordance with the Township's requirements;
- There will be regular maintenance of acoustic seals, mufflers, anti-vibration mounts, and other noise-reducing features on vehicles and equipment; and
- Equipment will be turned off when not in use, and unnecessary idling will be avoided when practical.

8.6 Dust Control

Fill deposition activities have the potential to generate fugitive dust emissions that could impact adjacent blueberry operations. To minimize impacts, additional precautions will be taken to minimize dust generation, including dust suppression and soil/stockpile management. Measures to minimize fugitive dust from exposed or un-vegetated cover soils will also be implemented.

Identification of Potential Sources of Fugitive Dust Emissions

The potential sources of fugitive dust at the Site are summarized in Table Q. For each potential source of fugitive dust emission, the potential causes and parameters that may impact dust emissions are identified in the table. A key step in controlling fugitive dust emissions is to evaluate each parameter and determine how it can be controlled.

Table V: Summary of Potential Sources of Fugitive Dust Emissions

Potential Sources of Fugitive Dust Emissions		Potential Causes of Dust Emissions	Parameters that May Impact Fugitive Dust Emissions
A	Unpaved Roads/Areas: • Unpaved roads • Haul trucks • Excavators	• Suspension (by traffic movement or wind) of fines generated from heavy traffic/equipment movement • Traffic movement onsite	• Moisture content • Surface silt loading • Vehicle speed • Distance travelled
B	Material Stockpiles	• Low moisture content • Disturbing the storage pile • Wind erosion of the storage piles	• Moisture content • Fines content • Wind erosion • Stockpile height

Fugitive Dust Control Methodology

Control measures and inspection observation criteria for fugitive dust emissions from Unpaved Roads/Areas and Material Stockpiles is summarized in Tables R and S.

Table W: Source of Fugitive Dust Emissions: Unpaved Roads/Areas

Potential Cause(s) of Fugitive Dust	Control Methodology and Frequency	Inspection Observation Criteria
Suspension by traffic	• Apply water as a dust suppressant (e.g., access roads)	• Check that mobile equipment when driving the speed limit has no observable dust being kicked up by the tires • Check that road surfaces have no observable tracking of dust and dirt • Check that road surfaces have a visible crust or hard surface
Traffic movement onsite	• Speed limit maximum of 20km/hr. • Clean trucks prior to leaving the Site during inclement weather to reduce mud tracking	• Check if drivers are travelling the speed limit • Check trucks are clean when they leave the Site and are not tracking dirt offsite

Table X: Source of Fugitive Dust Emissions: Material Stockpiles

Potential Cause(s) of Fugitive Dust	Control Methodology and Frequency	Inspection Observation Criteria
Low moisture content	• Moisture level of material must be high enough to prevent silt/dust from leaving the pile	• Check that no observable plume or dust leaves the stockpile
Disturbing the stockpile	• Excavation operators must limit the disturbed area of the stockpile during shipping	
High stockpile height	• Minimize the height of stockpiles	
Wind erosion	• Cover piles or ensure pile surface has a hard surface (i.e., dust suppressant) on the windward side • Work from one side of the pile, if possible, to minimize the disturbance of material	

Stockpiled materials will be placed within the designated, temporary stockpile storage areas, and graded by the contractor to shed water. If dust suppression becomes necessary during the soil stockpiling, at the discretion of the environmental consultant, exposed soils will be wetted by the contractor.

9.0 MANAGEMENT INPUTS

Developing soils following reclamation will require management inputs and practices to maximize agricultural production. Irrigation is required for both parcels. Additionally, incorporation of organic matter and lime/fertilizer application will likely be required to maximize agricultural capability.

Dominant soil limitations and associated management inputs for each soil series have been identified, and management inputs required to improve the agricultural capability are summarized below Bertrand et al. (1991).

Table Y: Management Inputs for Strong Pit Following Reclamation

Soil Series	Dominant Soil Limitation	Management Inputs
Abbotsford	• Low water and nutrient-holding capacity where surface loess is <50cm over outwash or glacial till • Soils are moderately to highly erosion prone where slopes >5%	• Irrigation System
Columbia	• Low nutrient supplying and holding capacity • Low water-holding capacity • Some areas are excessively stony	• Irrigation system • Lime and/or fertilizer Application • Organic Matter Incorporation • Stone removal

9.1 Irrigation System

Supplemental irrigation is required for the local climate and Abbotsford and Columbia soils which form part of the proposed soils required for reclamation. Supplemental irrigation is typically required for the period of May through September when evapotransportation rates exceed precipitation and a climatic moisture deficit occurs.

Designing an appropriate irrigation system requires a good understanding of the soil, crop, and moisture relationships. Design of any irrigation system should consider the following criteria and is explained in further detail in the Soil Management Handbook for the Lower Fraser Valley:

- Maximum Soil Water Deficit – the maximum allowable amount of water to be removed from soil before irrigation is required. It is calculated based on a crop's rooting depth, availability coefficient, and soils available water storage capacity;
- Maximum Irrigation System Application Rate – based on the infiltration capability of the soil where the application rate does not result in runoff, ponding of water, and puddling of the soil under the irrigation system;
- Maximum Irrigation Interval – the maximum number of days between irrigations that a crop can sustain optimum growth and production. Irrigation should be started for most crops when 50% of the soil available for plants has been depleted; and
- Irrigation System Water Requirement – the volume, quality, and availability of water required for the proposed irrigation program.

9.2 Lime and/or Fertilizer Application

In their natural state, Columbia soils have limitations which require high levels of fertilizer and lime inputs. Common liming materials used to maintain soil pH at levels high enough for good plant growth include ground limestone, ground dolomite, and hydrated lime. For best results, lime should be applied in the fall or a few weeks before seeding, and thoroughly incorporated into the plow layer.

While fertilizers can be applied to effectively overcome nutrient deficiencies in soil, good soil management is essential. Supplementary practices including crop rotation and organic matter additions are required to ensure good soil structure and organic matter levels.

Macro- and micro-nutrient concentrations required to produce excellent and average growing conditions for field crops for each analyzed stockpile are included in Appendix 2. Analysis of soil fertility for any additional topsoil imported to site should be completed to determine fertilizer needs.

9.3 Organic Matter Incorporation

Incorporation of organic matter into soils was recommended for Columbia soils, owing to their low nutrient and moisture holding capacity. Incorporation of organic matter will provide a food supply for soil organisms which, following decomposition, will release plant nutrients and promote better soil structure. Sandy soils will benefit form the improved moisture holding capacity and fertility while fine-textured soils will benefit from the improved granular structure.

10.0 STATEMENT OF LIMITATIONS AND CONDITIONS FOR REPORT

10.1 Complete Report

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to PGL by the Client, communications between PGL and the Client, and any other reports, proposals or documents prepared by PGL for the Client relative to the specific site described herein, all of which together constitute the Report.

In order to properly understand the suggestions, recommendations and opinions expressed herein, reference must be made to the whole of the Report. **PGL is not responsible for use by any part of portions of the Report without reference to the whole report.**

10.2 Basis of Report

The Report has been prepared for the specific site and purposes that are set out in the contract between PGL and the Client. The findings, recommendations, suggestions, or opinions expressed in the Report are only applicable to the site and purposes in relation to which the Report is expressly provided, and then only to the extent that there has been no material alteration to or variation from the information provided or available to PGL.

10.3 Use of the Report

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. No other party may use or rely upon the Report or any portion thereof without PGL's written consent, and such use shall be on terms and conditions as PGL may expressly approve. Ownership in and copyright for the contents of the Report belong to PGL. Any use which a third party makes of the Report, is the sole responsibility of such third party. **PGL accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report.**

11.0 CLOSING

Respectfully submitted,

PGL ENVIRONMENTAL CONSULTANTS

Per:

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Senior Consultant & Chairman

CSB/ELP/ncb/mtl
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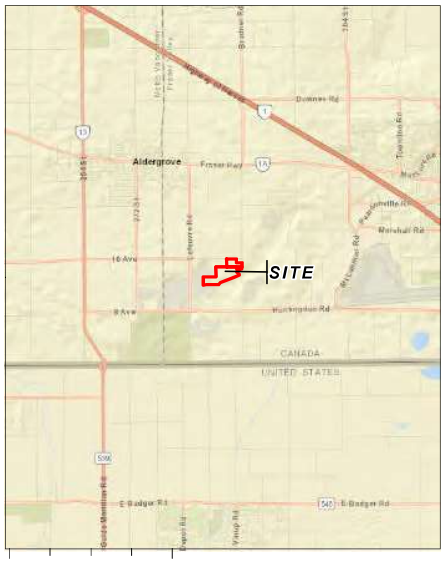
Figures



Site Boundary (Approximate)

Watercourse

Contour

Parcel boundary and site features are approximate and are presented for discussion purposes only.

0 1:4,500 240 m

2019 orthoimage and street map from ESRI
Parcel data from City of Abbotsford Open Data
NAD 1983 UTM Zone 10N

SITE LOCATION

Strong Pit - 1461 Bradner Road, Abbotsford, BC

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

PGL ENVIRONMENTAL CONSULTANTS

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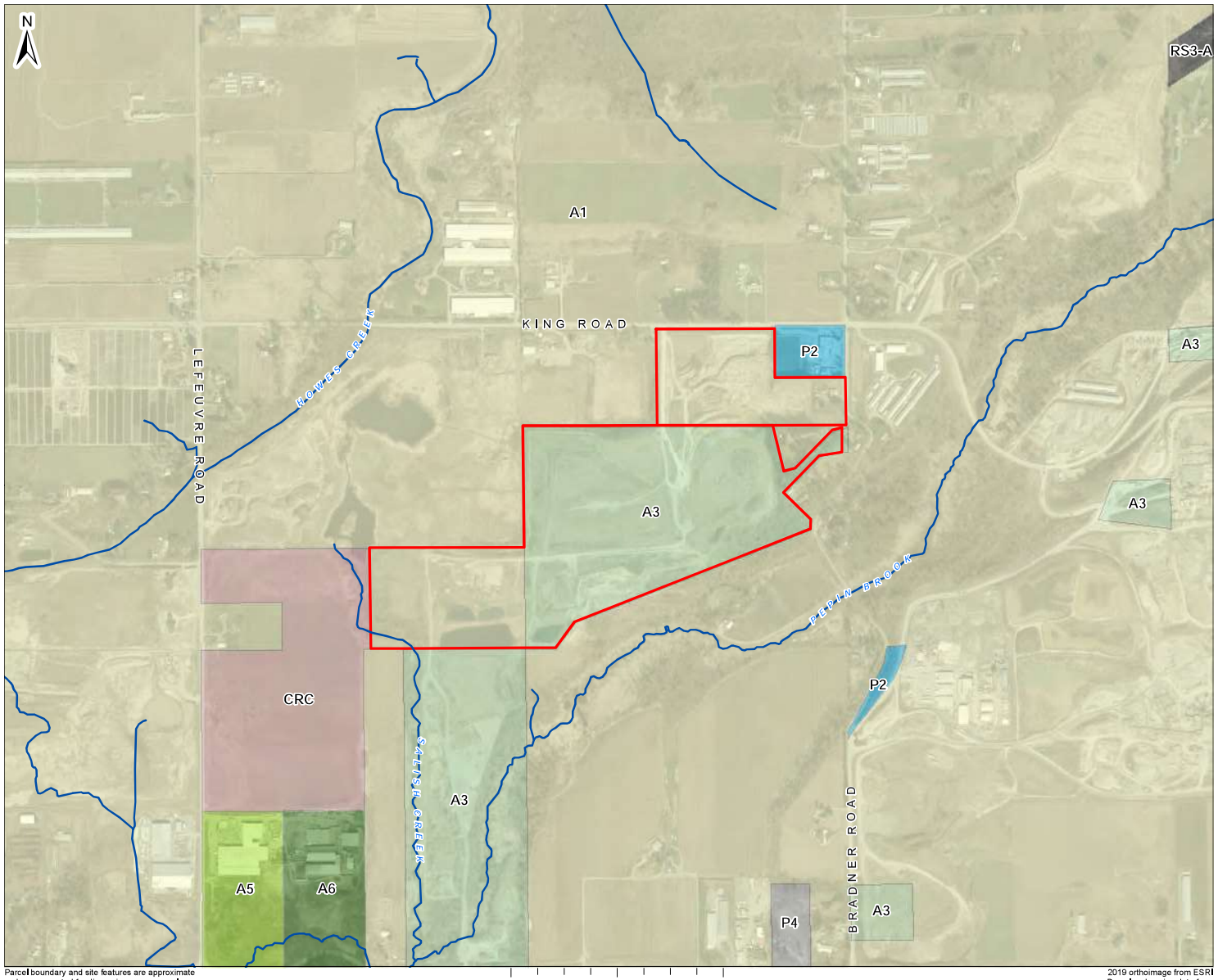

- Site Boundary (Approximate)
- A1 - Agricultural One Zone
- A3 - Agricultural and Resource Processing Zone
- A5 - Agricultural and Farm Industrial Zone
- A6 - Agricultural and Commercial Mushroom Composting Zone
- CRC - Recreation and Campground Zone
- P2 - Parks, Open Space and School Zone
- P4 - Special Housing Zone
- RS3-A - Urban Residential Zone
- Watercourse

ZONING MAP

Strong Pit - 1461 Bradner Road, Abbotsford, BC

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

PGL ENVIRONMENTAL CONSULTANTS

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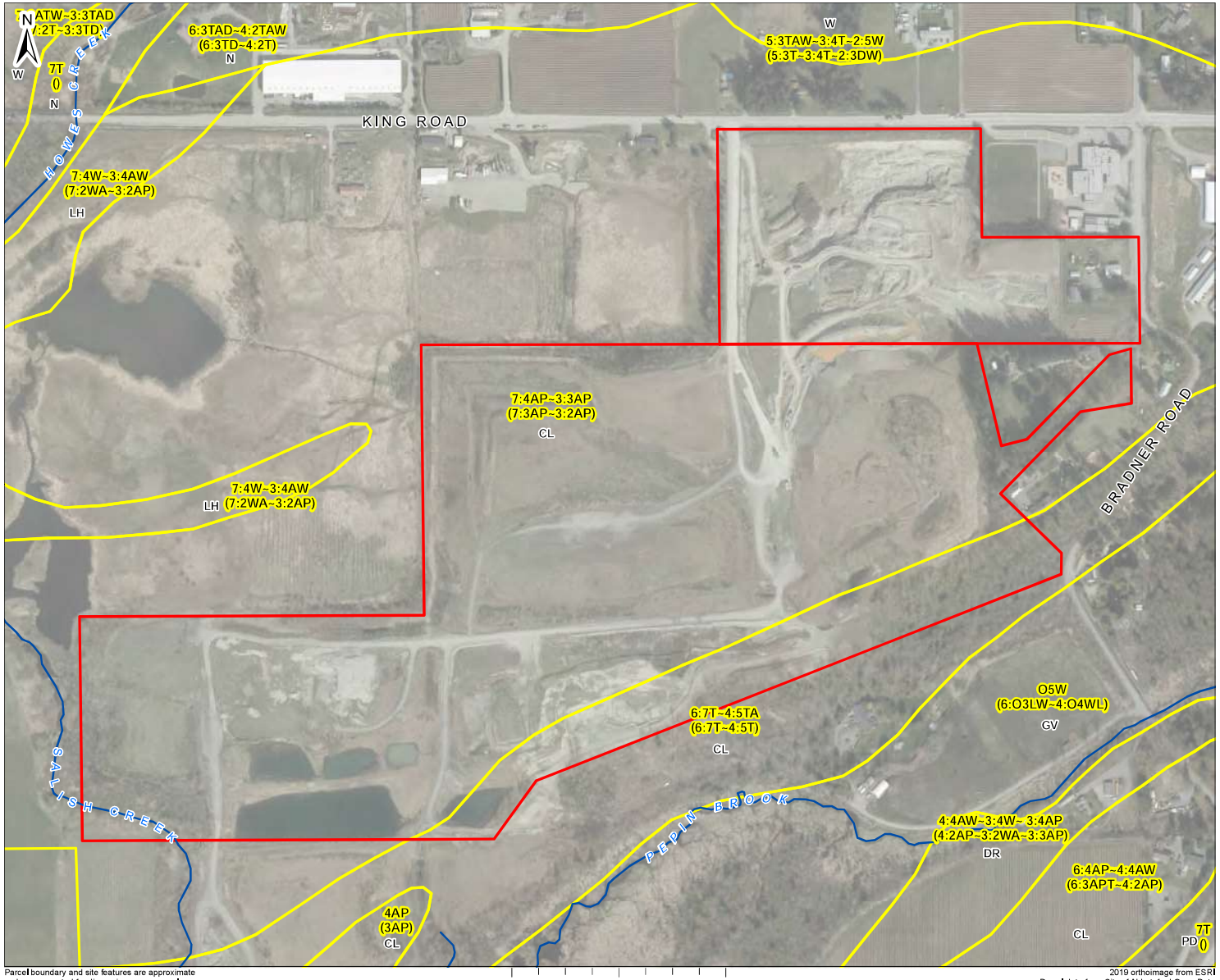

Site Boundary (Approximate)

Soil Polygon

Watercourse

Land Capability for Agriculture Map Symbols

Percentage of Map Unit
- Capability Subclasses
- Organic Soil Capability

Unimproved Rating — 5:5TA 5:7T
Improved Rating — (5:5T 5:7T)

Mineral Soil Capability Class — Improved Capability Subclasses

Land Capability Subclass for Mineral Soils

D Undesirable soil structure and/or low perviousness
N Salinity
T Topography
W Excess water

Land Capability Subclass for Organic Soils

L Degree of decomposition - permiability

Soil Names

CL Columbia
DR Defehr
GV Glen Valley
LH Lehman
N Nicholson
PD Peardonville
W Whatcom

Parcel boundary and site features are approximate and are presented for discussion purposes only.

0 1:4,500 240 m

2019 orthoimage from ESRI
Parcel data from City of Abbotsford Open Data
Soil data from British Columbia Open Data
NAD 1983 UTM Zone 10N

SOIL SERIES AND AGRICULTURAL CAPABILITY PRE-EXTRACTION

Strong Pit - 1461 Bradner Road, Abbotsford, BC

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

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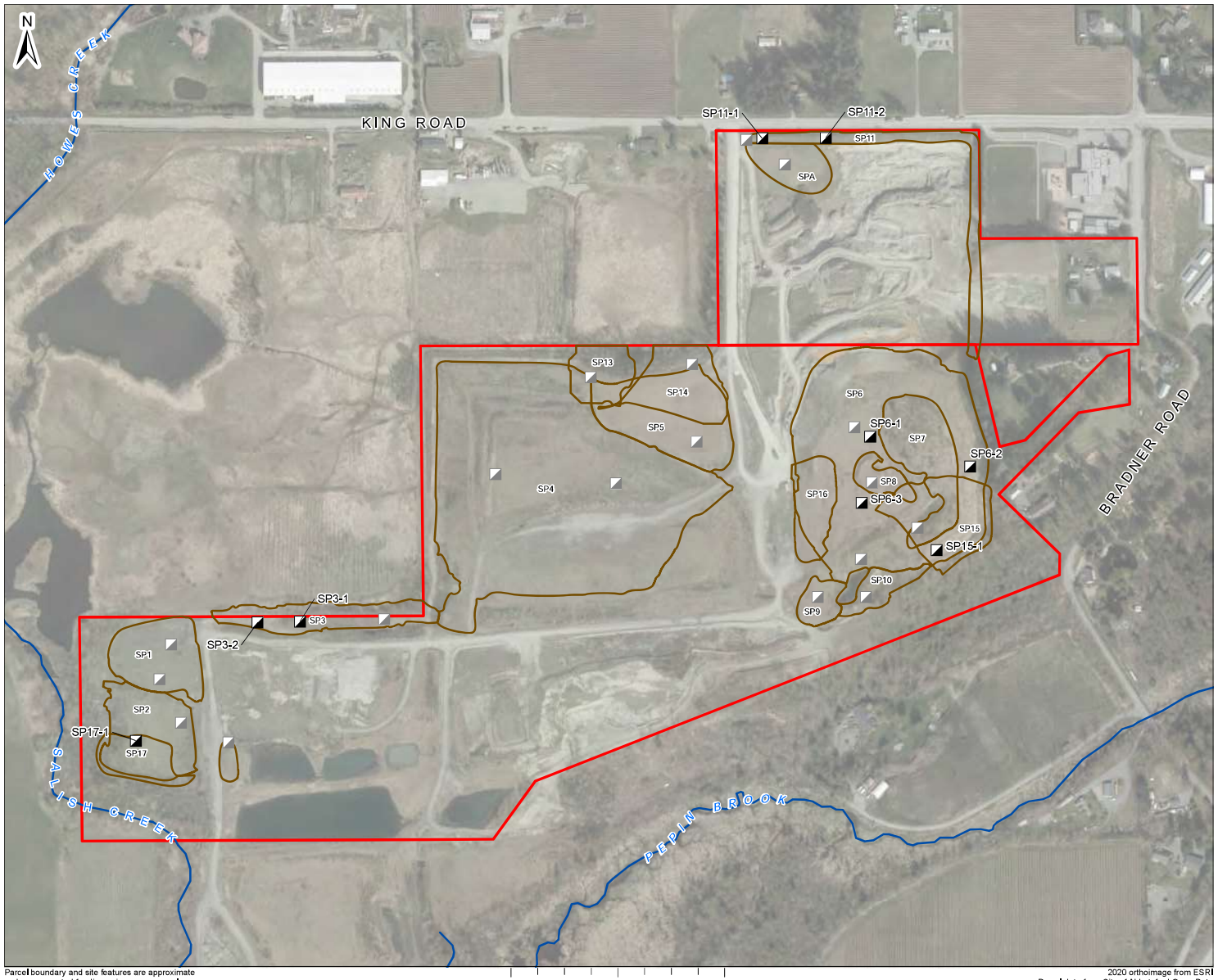

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SITE PLAN AND INVESTIGATION LOCATIONS

Strong Pit - 1461 Bradner Road, Abbotsford, BC

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

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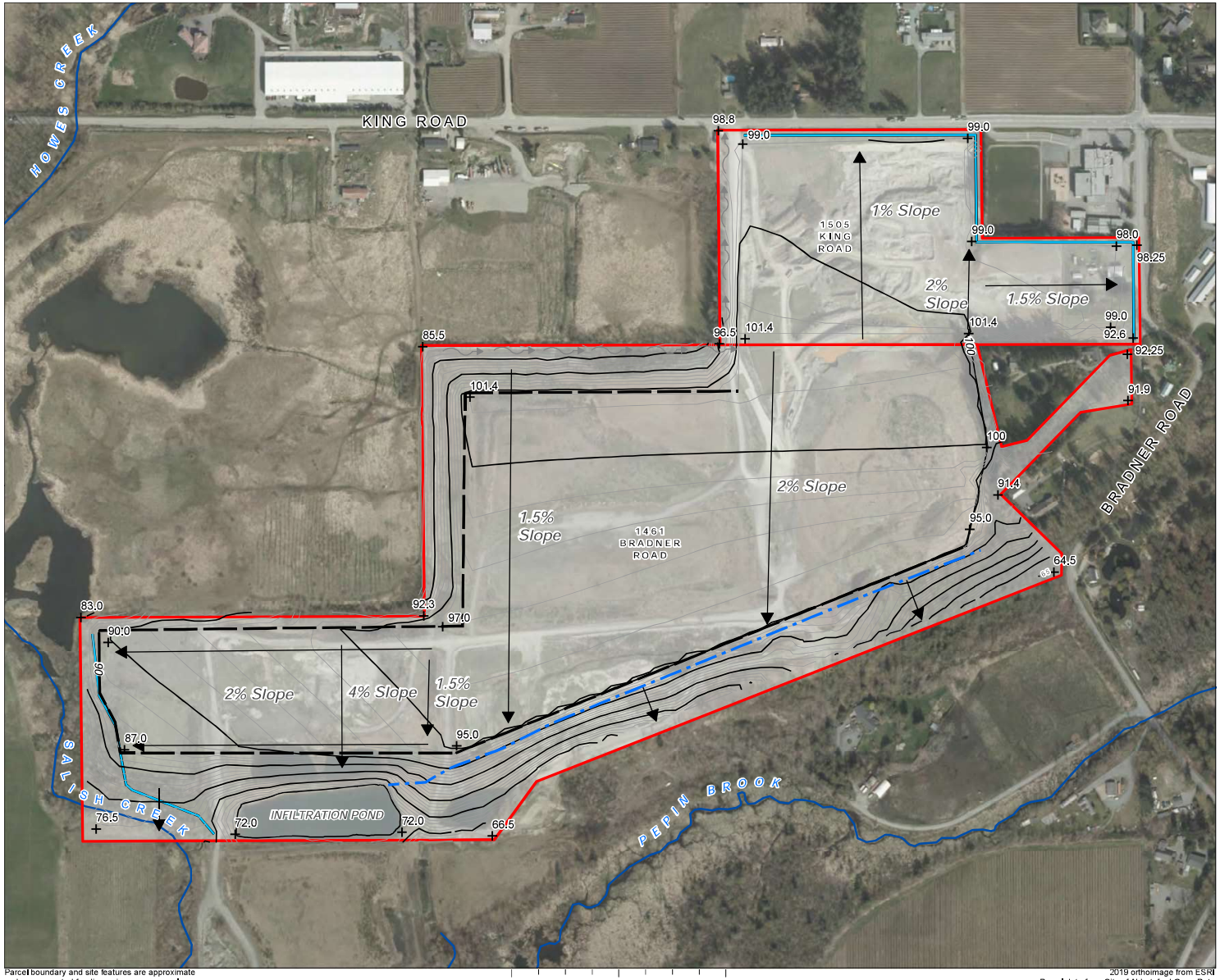

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Parcel data from City of Abbotsford Open Data
NAD 1983 UTM Zone 10N

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STRONG PIT - FVA CONCEPTUAL GRADING SCENARIO 1

Strong Pit - 1461 Bradner Road, Abbotsford, BC

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

PGL ENVIRONMENTAL CONSULTANTS

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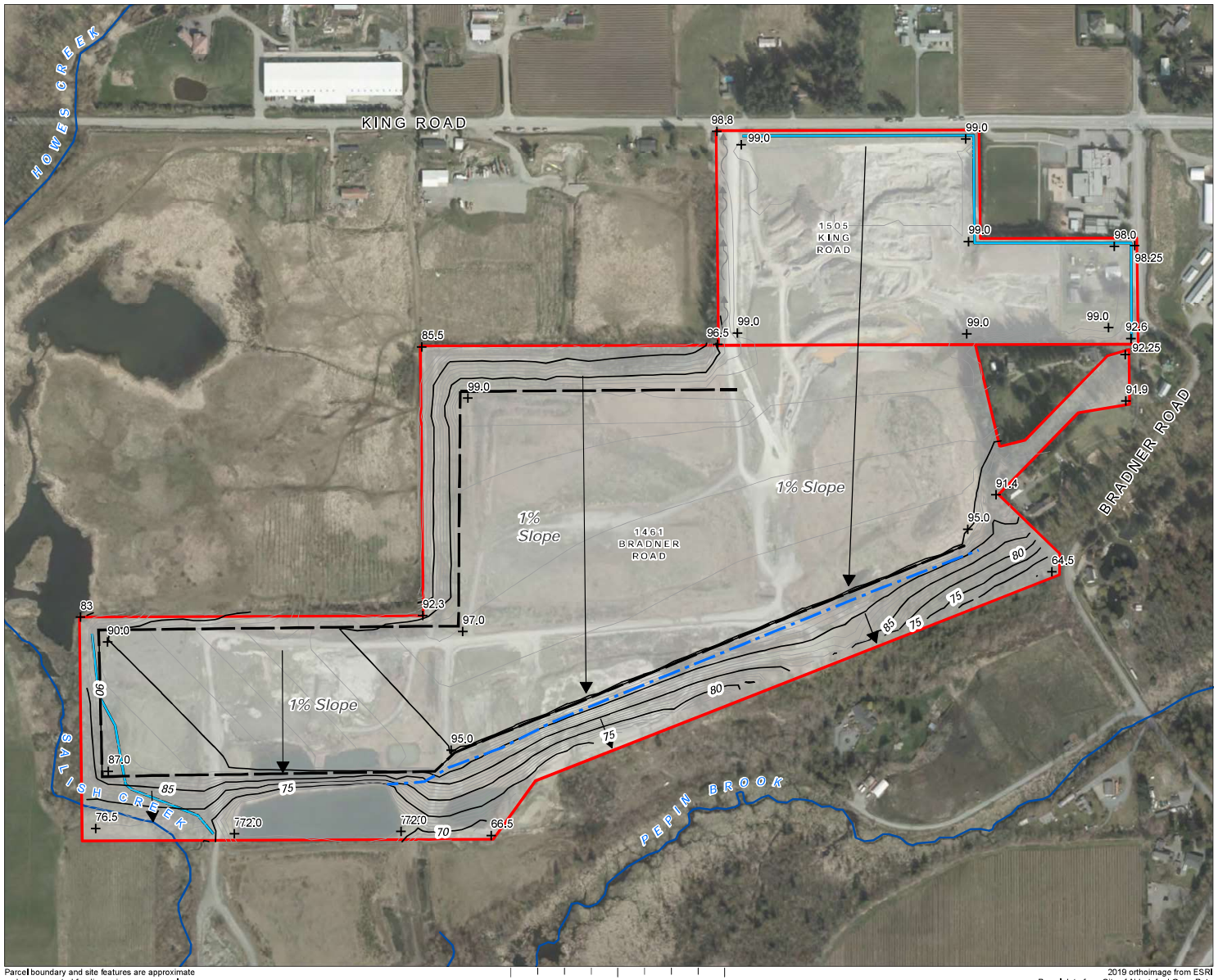

Site Boundary (Approximate)
Watercourse
Contour
Infiltration Area
Drainage Swale
Slope
Intercept Ditch
Top of Slope

N

Parcel boundary and site features are approximate and are presented for discussion purposes only.

Contour interval 1m

0 1:4,500 240 m

2019 orthoimage from ESRI
Parcel data from City of Abbotsford Open Data
NAD 1983 UTM Zone 10N

STRONG PIT - CONCEPTUAL GRADING SCENARIO 1

Strong Pit - 1461 Bradner Road, Abbotsford, BC

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

PGL ENVIRONMENTAL CONSULTANTS

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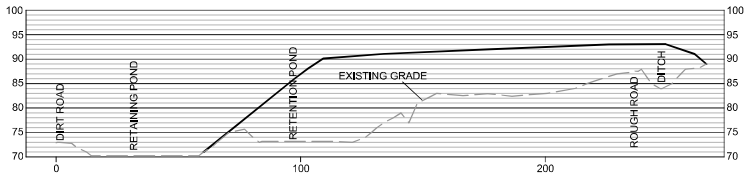

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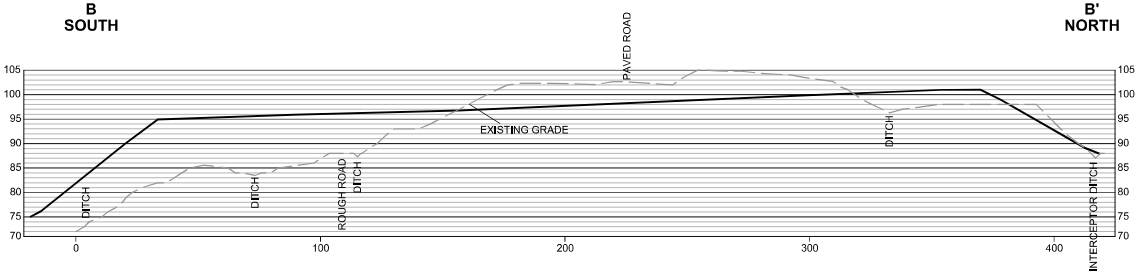

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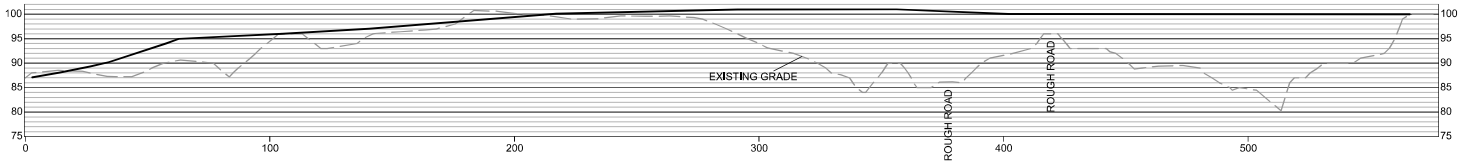

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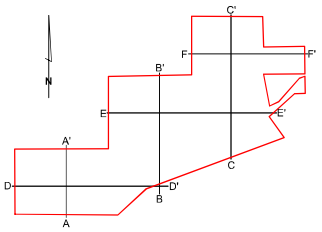

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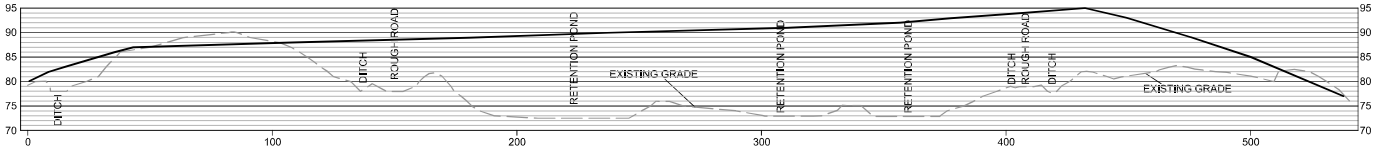

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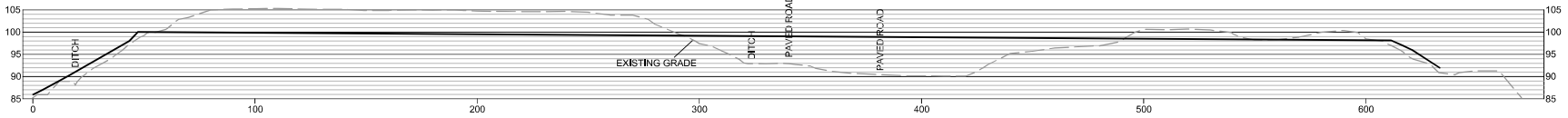

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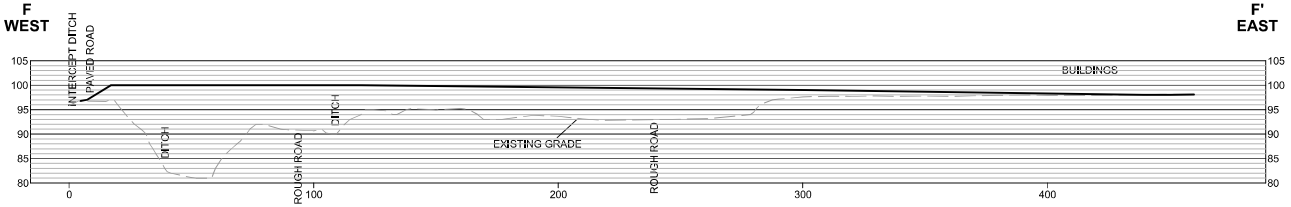

HORIZONTAL SCALE 1:2000
VERTICAL SCALE 1:1000
VERTICAL EXAGGERATION 2X
ALL DISTANCED IN METRES
Sections are conceptual and are presented for discussion purposes only.

CROSS SECTIONS: STRONG PIT
FVA CONCEPTUAL GRADING SCENARIO 1

Strong Pit - 1461 Bradner Road, Abbotsford, BC

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

PGL ENVIRONMENTAL CONSULTANTS

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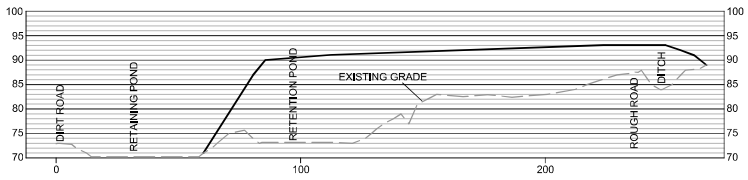
SOUTH

A'
NORTH



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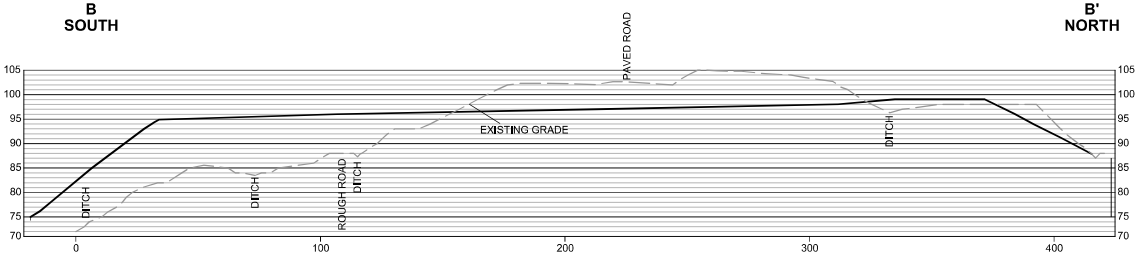
SOUTH

B'
NORTH



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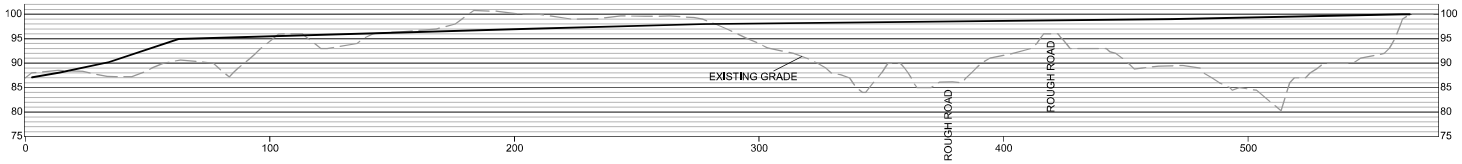
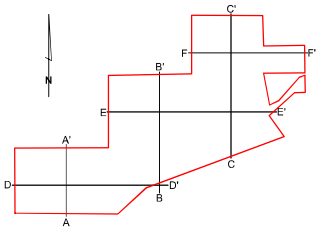
C'
NORTH

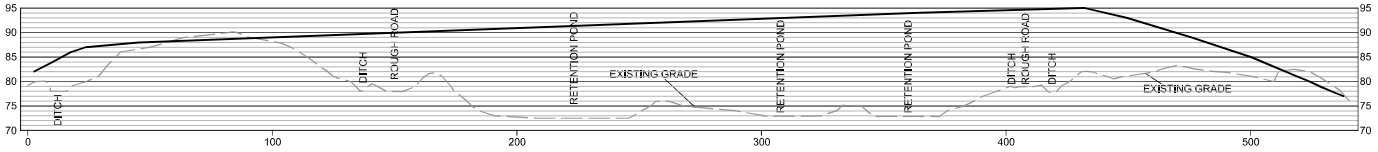


CROSS SECTION LAYOUT



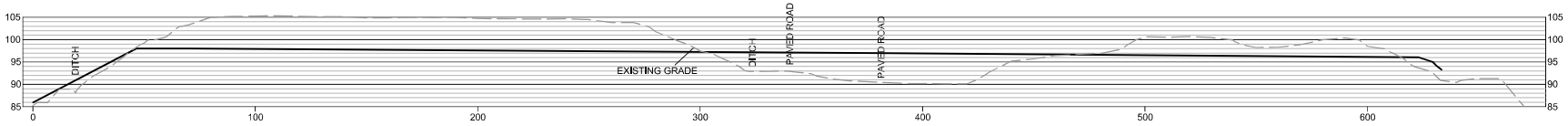
D
WEST

D'
EAST



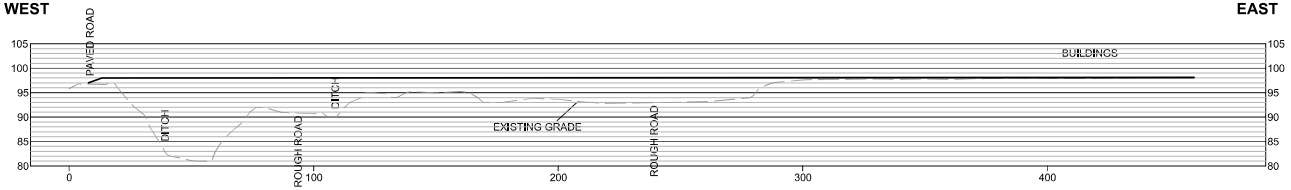
E
WEST

E'
EAST



F
WEST

F'
EAST



HORIZONTAL SCALE 1:2000
VERTICAL SCALE 1:1000
VERTICAL EXAGGERATION 2X
ALL DISTANCED IN METRES
Sections are conceptual and are presented for discussion purposes only.

CROSS SECTIONS: STRONG PIT
CONCEPTUAL GRADING SCENARIO 1

Strong Pit - 1461 Bradner Road, Abbotsford, BC

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

PGL ENVIRONMENTAL CONSULTANTS

File No.:	Dwg.:	Figure
0346-55.01	RP_0082	8
Date: FEB 2022	Drawn by: IRB	

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Appendix 1

Site Photographs

PGL
ENVIRONMENTAL CONSULTANTS

Photograph 1:

North parcel which has been previously backfilled with bulk fill

Photograph 2:

Current edge treatment along King Road

Photograph 3:

Complex topography resulting from current configuration of stockpiles looking north from SP6

Photograph 4:

Soil pit excavated in SP3

Photograph 5:

Soil pit excavated in SP17

Photograph 6:

Soil pit excavated in SP6

Photograph 7:

Soil pit excavated in SP6

Photograph 8:

Soil pit excavated in SP11

Appendix 2

Laboratory Reports

PGL
ENVIRONMENTAL CONSULTANTS

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W: www.element.com

Farm Soil Analysis

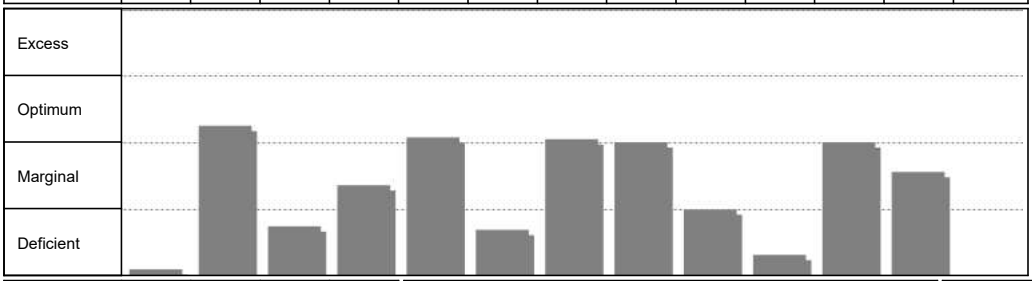
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628630
		Field Id:	SP3-1-1	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	34	56	4	265	21	64.4	0.8	<0.5	0.1	2.5	6.2	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
5.8	0.2	2.9	7511963



Alkaline	*Extreme*	*High*	
Neutral	*Very High*	*Normal*	
Acidic	*High*	*Low*	
Very Acidic	*Good*	*Very Low*	

Total lbs/acre	4	68	112	8
Estimated lbs/acre	8	68	112	16

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 1.6 meq/100 g
Ca 80.8 % Mg 10 % Na <8.0 % K 8.8 %
TEC 1.6 meq/100 g Na <30 ppm

Lime <0.4 T/ac Buffer pH 7.2 Est. N Release n/a K/Mg Ratio 0.84

*Nitrate-N **Sulfate-S n/a = not analysed

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	97	19	86	14	1.5	10	11	95	12
Average	2.8	73	12	74	9	1.2	9	10	90	12
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 159	0 / 46	0 / 201	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	7.0	2.0	0.0	0.0	0.0	7.0	2.0	0.0

Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.
This soil is high in sodium (sodic).

Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.
This soil is high in sodium (sodic).

Comments:

Element uses nutrient extraction and analytical methods specifically developed for western Canadian soils.

The modified Kelowna extractant used to analyze key nutrients in this Farm Soil Analysis report is the standard method used in soil fertility research in western Canada. It is used in developing crop response curves to fertilizer in Alberta. The Element "RECOMMENDATIONS FOR BALANCED CROP NUTRITION" are based on those research data. Element recommendations are accurate but should not replace responsible judgement.

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Farm Soil Analysis

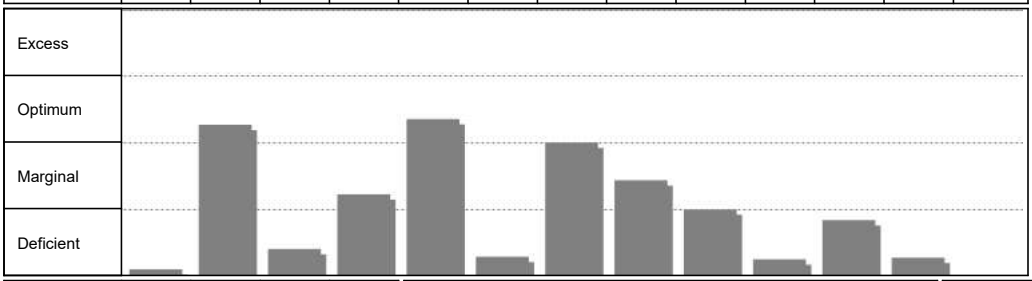
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628631
		Field Id:	SP3-2-1	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	35	31	3	486	9	13.7	0.5	<0.5	<0.1	0.8	1	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.0	0.26	0.8	7511964



Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Total lbs/acre	4	69	61	6
Estimated lbs/acre	8	69	61	13

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 2.6 meq/100 g
Ca 94.2 % Mg 3 % Na <5.1 % K 3.1 %
TEC 2.6 meq/100 g Na <30 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 1

**Nitrate-N* ***Sulfate-S* *n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	96	19	105	15	1.5	10	11	121	14
Average	2.8	71	11	94	11	1.2	9	10	117	14
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 158	0 / 46	0 / 200	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	7.0	2.0	1.5	0.0	0.0	7.0	2.0	1.5

Parts of the field may be Iron deficient.
Copper may be low for cereals in rotation.
Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.
Add Manganese or try a test strip.
Magnesium %BS is low.
This soil is high in sodium (sodic).

Parts of the field may be Iron deficient.
Copper may be low for cereals in rotation.
Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.
Add Manganese or try a test strip.
Magnesium %BS is low.
This soil is high in sodium (sodic).

Comments:

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Farm Soil Analysis

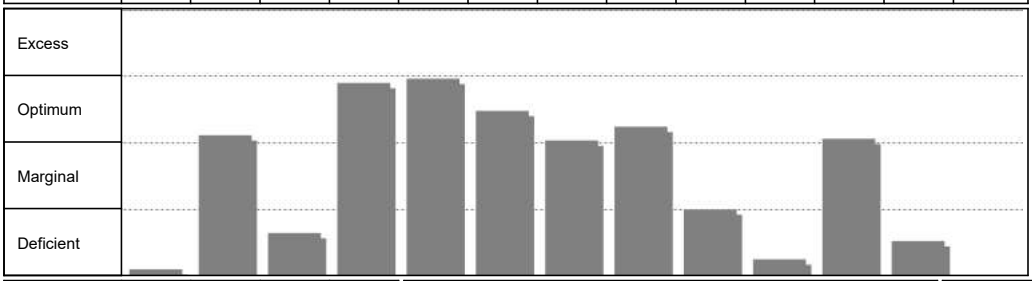
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628632
		Field Id:	SP6-1-1	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	29	49	18	971	136	45.2	1.8	<0.5	<0.1	5.0	2	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.4	0.2	1.4	7511965



Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Total lbs/acre	4	58	97	37
Estimated lbs/acre	8	58	97	75

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 6.3 meq/100 g
Ca 77.2 % Mg 17.8 % Na 3.0 % K 2.0 %
TEC 6.3 meq/100 g Na 44 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 0.11

**Nitrate-N* ***Sulfate-S* *n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	99	19	92	0	1.5	10	15	103	0
Average	2.8	75	12	80	0	1.2	9	11	99	0
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 159	0 / 46	0 / 201	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	7.0	2.0	0.0	0.0	0.0	7.0	2.0	0.0

Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.

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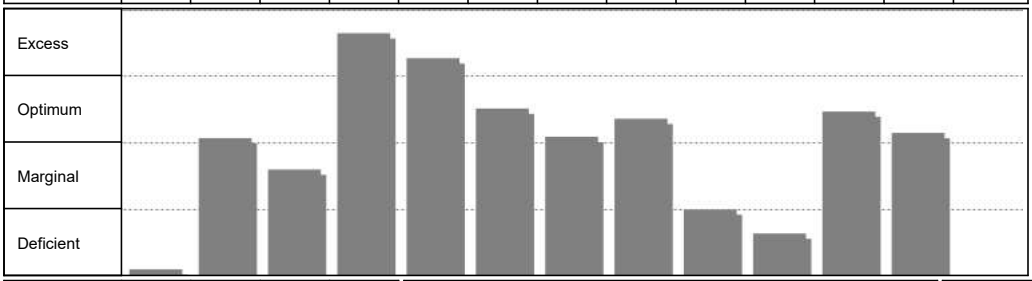
W: www.element.com

Farm Soil Analysis

Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628633
		Field Id:	SP6-1-2	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	28	120	166	3440	143	100	2.3	<0.5	0.3	24.5	22	



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.8	0.82	1.2	7511966

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Total lbs/acre	4	55	240	331
Estimated lbs/acre	8	55	240	675

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 19.0 meq/100 g
Ca 90.5 % Mg 6.2 % Na 1.7 % K 1.6 %
TEC 19.0 meq/100 g Na 73 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 0.26

**Nitrate-N **Sulfate-S n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.3	103	21	39	0	1.5	10	17	29	0
Average	2.8	79	13	26	0	1.2	9	13	23	0
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.3	0 / 160	0 / 47	0 / 203	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	7.0	2.0	0.0	0.0	0.0	7.0	2.0	0.0

Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.

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Farm Soil Analysis

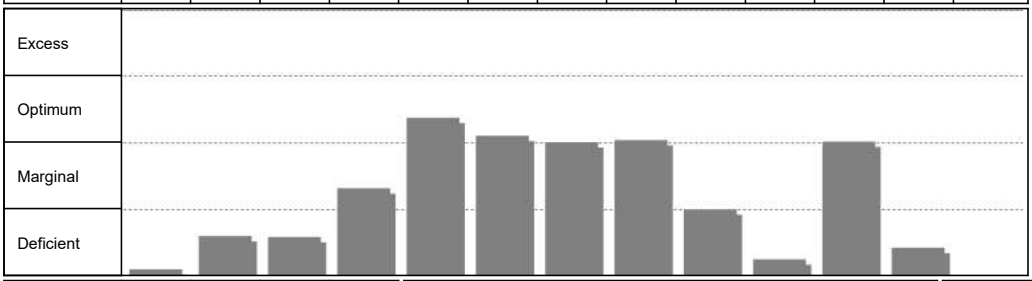
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628634
		Field Id:	SP6-2-1	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	9	44	4	502	53	19.6	1.0	<0.5	<0.1	2.9	2	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.7	0.08	<0.1	7511967



Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Total lbs/acre	4	18	88	8
Estimated lbs/acre	8	18	88	15

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 3.1 meq/100 g
Ca 81.9 % Mg 14 % Na <4.3 % K 3.7 %
TEC 3.1 meq/100 g Na <30 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 0.26

*Nitrate-N **Sulfate-S n/a = not analysed

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	92	39	95	14	1.5	10	44	108	13
Average	2.8	67	32	83	9	1.2	9	40	104	12
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 157	0 / 46	0 / 199	0 / 19	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	7.0	2.0	0.0	0.0	0.0	7.0	2.0	0.0

Parts of the field may be Iron deficient.
Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.

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Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
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Farm Soil Analysis

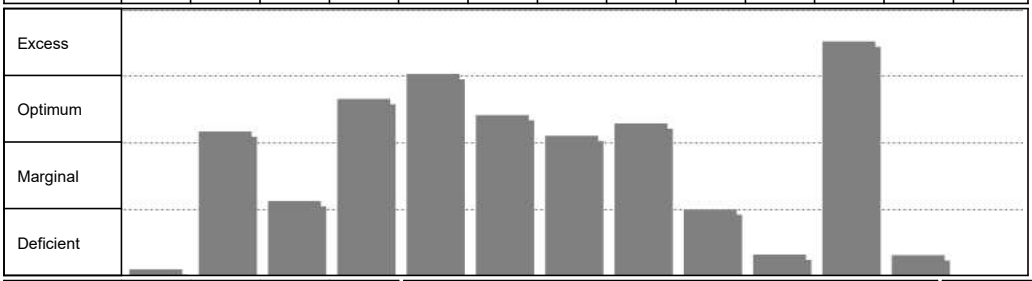
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628635
		Field Id:	SP6-2-2	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	31	84	15	1310	122	115	2.0	<0.5	0.1	128	1	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.0	0.21	1.3	7511968



Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Total lbs/acre	4	62	169	31
Estimated lbs/acre	8	62	169	63

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 8.0 meq/100 g
Ca 81.9 % Mg 12.5 % Na 2.8 % K 2.7 %
TEC 8.0 meq/100 g Na 52 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 0.22

**Nitrate-N **Sulfate-S n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	101	19	65	0	1.5	10	12	66	0
Average	2.8	77	12	53	0	1.2	9	8	61	0
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 160	0 / 47	0 / 202	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	7.0	2.0	n/a	0.0	0.0	7.0	2.0	n/a

Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.

Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.

Comments:

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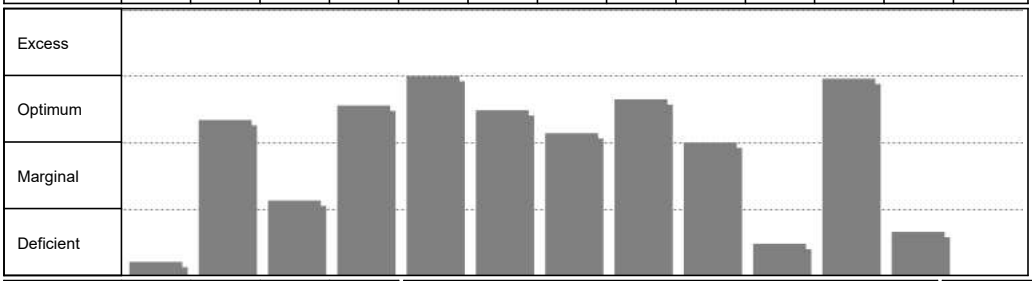
Farm Soil Analysis

Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628636
		Field Id:	SP6-2-3	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	4	37	85	14	1040	138	153	3.5	1	0.2	48.3	3	



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.0	0.2	1.9	7511969

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

	N	P	K	S
Total lbs/acre	8	74	170	28
Estimated lbs/acre	17	74	170	58

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 6.8 meq/100 g
Ca 76.4 % Mg 16.7 % Na 3.7 % K 3.2 %
TEC 6.8 meq/100 g Na 57 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 0.19

**Nitrate-N **Sulfate-S n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.3	95	19	65	0	1.5	10	11	65	0
Average	2.8	71	12	53	0	1.2	10	10	60	0
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.3	0 / 160	0 / 47	0 / 203	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0
	Add Boron or try a test strip.					Add Boron or try a test strip.				

Comments:

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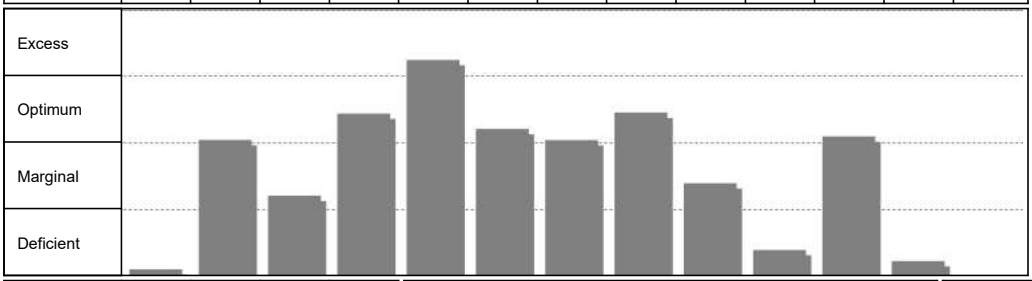
Farm Soil Analysis

Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628637
		Field Id:	SP6-3-1	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	27	91	13	3210	76	50.3	2.7	0.7	0.2	6.6	0.9	



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
8.3	0.26	1.2	7511970

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

	N	P	K	S
Total lbs/acre	4	53	181	25
Estimated lbs/acre	8	53	181	52

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 16.9 meq/100 g
Ca 94.9 % Mg 3.7 % Na <0.8 % K 1.4 %
TEC 16.9 meq/100 g Na <30 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 0.37

*Nitrate-N **Sulfate-S n/a = not analysed

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	101	22	61	0	1.5	10	19	59	0
Average	2.8	77	14	49	0	1.2	9	15	54	0
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 160	0 / 47	0 / 202	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0

Add Boron or try a test strip.
Magnesium %BS is low.

Parts of the field may be Zinc deficient.
Add Boron or try a test strip.
Magnesium %BS is low.

Comments:

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Farm Soil Analysis

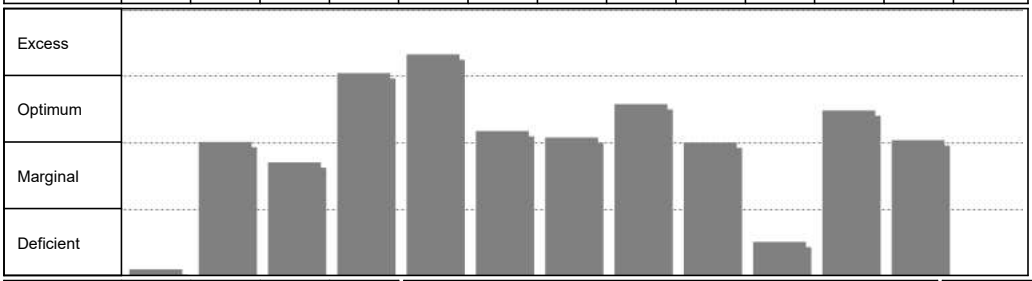
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628638
		Field Id:	SP6-3-2	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	25	128	30	3960	69	89.2	3.2	1	0.2	25.3	12	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
8.5	0.35	1.8	7511971



Alkaline	*Extreme*	*High*	
Neutral	*Very High*	*Normal*	
Acidic	*High*	*Low*	
Very Acidic	*Good*	*Very Low*	

	N	P	K	S
Total lbs/acre	4	51	256	61
Estimated lbs/acre	8	51	256	123

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 20.9 meq/100 g
Ca 94.4 % Mg 2.7 % Na 1.3 % K 1.6 %
TEC 20.9 meq/100 g Na 64 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 0.58

**Nitrate-N **Sulfate-S n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.3	103	23	33	0	1.5	10	20	20	0
Average	2.8	79	15	20	0	1.2	9	17	14	0
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.3	0 / 160	0 / 47	0 / 203	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0

Add Boron or try a test strip.
Magnesium %BS is low.

Add Boron or try a test strip.
Magnesium %BS is low.

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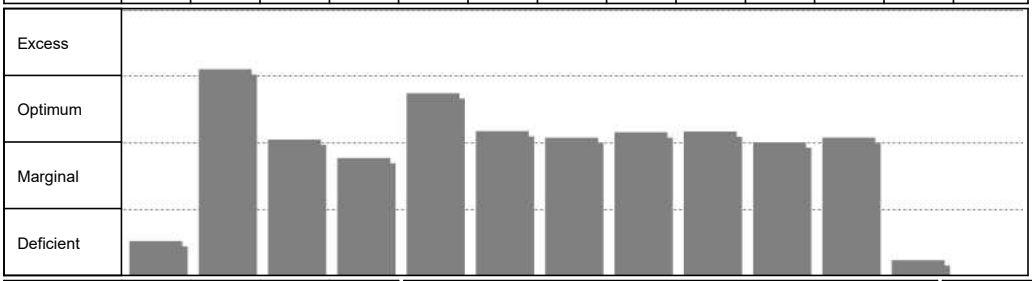
Farm Soil Analysis

Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628639
		Field Id:	SP11-1	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	10	>80	167	6	796	69	86.9	1.5	4.2	0.8	5.8	1.0	



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
6.3	0.2	3.7	7511972

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

	N	P	K	S
Total lbs/acre	21	160	334	12
Estimated lbs/acre	42	160	334	25

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 5.0 meq/100 g
Ca 80.0 % Mg 11 % Na <2.6 % K 8.6 %
TEC 5.0 meq/100 g Na <30 ppm

Lime <0.4 T/ac Buffer pH 7.2 Est. N Release n/a K/Mg Ratio 0.76

**Nitrate-N* ***Sulfate-S* *n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.3	81	0	28	14	1.5	0	0	15	5
Average	2.9	57	0	18	9	1.2	0	0	15	5
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.3	0 / 162	0 / 47	0 / 205	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

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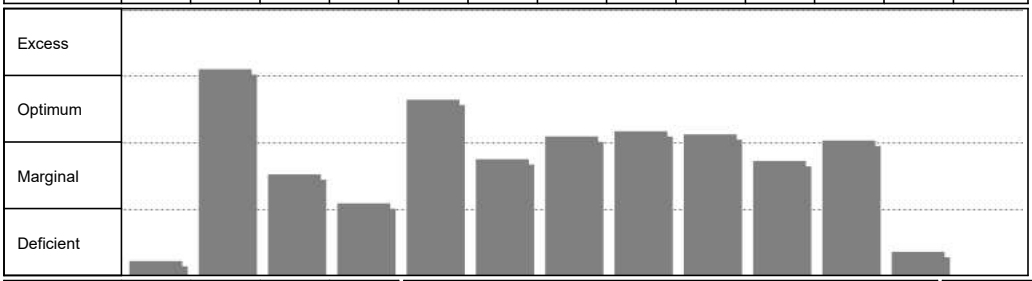
Farm Soil Analysis

Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628640
		Field Id:	SP11-2	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	4	>80	114	3	718	45	105	1.5	3.4	0.7	3.6	1	



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
6.5	0.09	4.1	7511973

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

	N	P	K	S
Total lbs/acre	9	160	229	5
Estimated lbs/acre	18	160	229	10

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 4.2 meq/100 g
Ca 84.4 % Mg 8.7 % Na <3.1 % K 6.9 %
TEC 4.2 meq/100 g Na <30 ppm

Lime <0.4 T/ac Buffer pH 7.1 Est. N Release n/a K/Mg Ratio 0.79

*Nitrate-N **Sulfate-S n/a = not analysed

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.3	95	0	43	17	1.5	10	0	34	17
Average	2.8	71	0	30	12	1.2	10	0	29	16
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.3	0 / 160	0 / 47	0 / 203	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Parts of the field may be Boron deficient.

Comments:

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Farm Soil Analysis

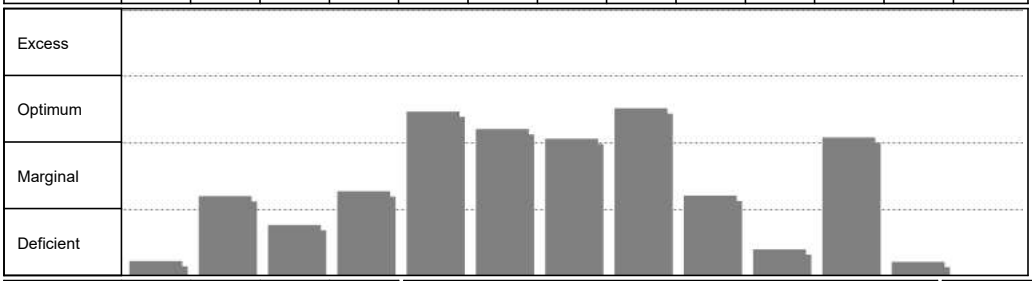
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628641
		Field Id:	SP15-1-1	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	5	17	57	4	575	76	71.6	3.0	0.6	0.2	5.9	0.8	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
6.2	0.1	5.4	7511974



Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Total lbs/acre	9	34	115	7
Estimated lbs/acre	18	34	115	14

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 3.6 meq/100 g
Ca 78.9 % Mg 17 % Na <3.6 % K 4.0 %
TEC 3.6 meq/100 g Na <30 ppm

Lime 0.4 T/ac Buffer pH 7.1 Est. N Release n/a K/Mg Ratio 0.24

**Nitrate-N* ***Sulfate-S* *n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	86	31	85	14	1.5	10	32	94	13
Average	2.8	62	23	73	10	1.2	10	28	89	13
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 158	0 / 46	0 / 200	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0

Add Boron or try a test strip.

Parts of the field may be Zinc deficient.
Add Boron or try a test strip.

Comments:

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Farm Soil Analysis

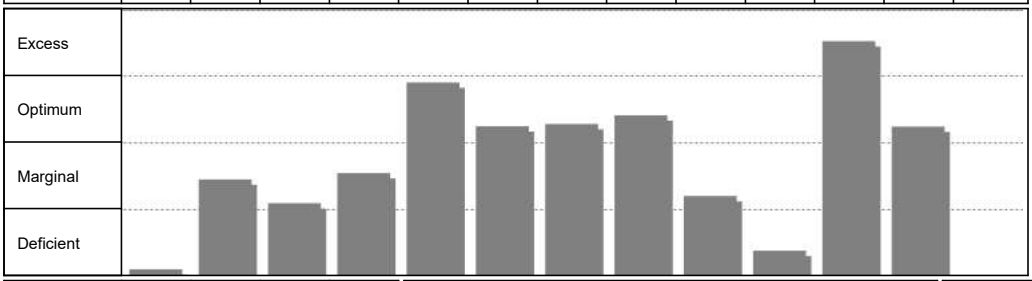
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628642
		Field Id:	SP15-1-2	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	20	82	5	925	85	290	2.5	0.6	0.2	129	30	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.1	0.2	4.9	7511975



Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Total lbs/acre	4	39	164	10
Estimated lbs/acre	8	39	164	20

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 5.9 meq/100 g
Ca 78.7 % Mg 12 % Na 5.8 % K 3.6 %
TEC 5.9 meq/100 g Na 79 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 0.30

**Nitrate-N **Sulfate-S n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	97	29	67	14	1.5	10	28	68	9
Average	2.8	72	21	55	9	1.2	9	25	63	9
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 159	0 / 46	0 / 201	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	0.0	2.0	n/a	0.0	0.0	0.0	2.0	n/a

Add Boron or try a test strip.
This soil is high in sodium (sodic).

Parts of the field may be Zinc deficient.
Add Boron or try a test strip.
This soil is high in sodium (sodic).

Comments:

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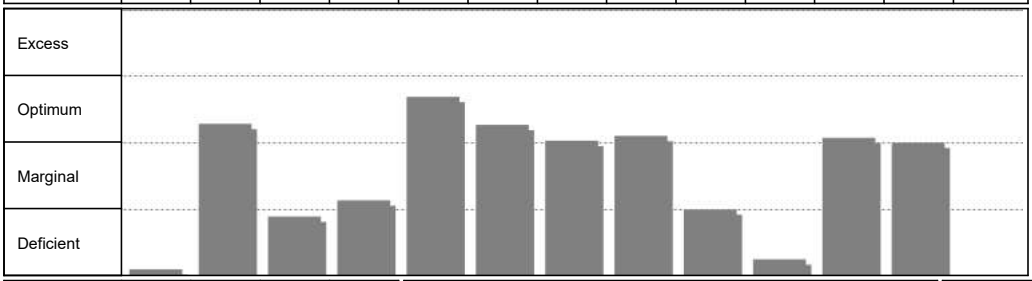
Farm Soil Analysis

Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628643
		Field Id:	SP15-2-1	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	35	67	3	753	89	41.2	1.2	<0.5	<0.1	5.6	8.3	



Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
7.7	0.07	1.2	7511976

Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

Total lbs/acre	4	70	134	5
Estimated lbs/acre	8	70	134	11

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 4.7 meq/100 g
Ca 80.6 % Mg 16 % Na <2.8 % K 3.7 %
TEC 4.7 meq/100 g Na <30 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 0.23

*Nitrate-N **Sulfate-S n/a = not analysed

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	97	19	78	16	1.5	10	11	84	16
Average	2.8	73	12	66	12	1.2	9	10	79	15
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 159	0 / 46	0 / 201	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	7.0	2.0	0.0	0.0	0.0	7.0	2.0	0.0

Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.

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Add Boron or try a test strip.

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Farm Soil Analysis

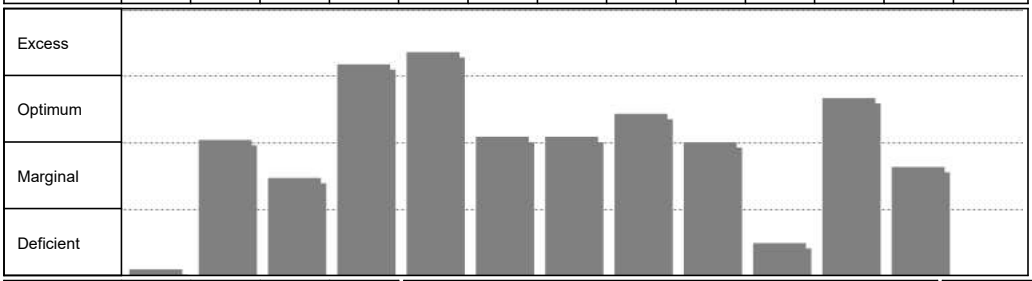
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628644
		Field Id:	SP15-2-2	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	26	111	60	4270	50	100.0	2.6	1	0.2	34.3	6.6	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
8.2	0.44	1.6	7511977



Alkaline	*Extreme*	*High*	
Neutral	*Very High*	*Normal*	
Acidic	*High*	*Low*	←
Very Acidic	*Good*	*Very Low*	←

Total lbs/acre	4	53	221	120
Estimated lbs/acre	8	53	221	245

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 22.3 meq/100 g
Ca 95.7 % Mg 1.9 % Na 1.2 % K 1.3 %
TEC 22.3 meq/100 g Na 62 ppm

Lime 0 T/ac Buffer pH Not Required Est. N Release n/a K/Mg Ratio 0.69

**Nitrate-N **Sulfate-S n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	102	22	46	0	1.5	10	19	38	0
Average	2.8	78	14	33	0	1.2	9	15	33	0
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 160	0 / 47	0 / 203	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0

Add Boron or try a test strip.
Magnesium %BS is low.

Add Boron or try a test strip.
Magnesium %BS is low.

Comments:

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Farm Soil Analysis

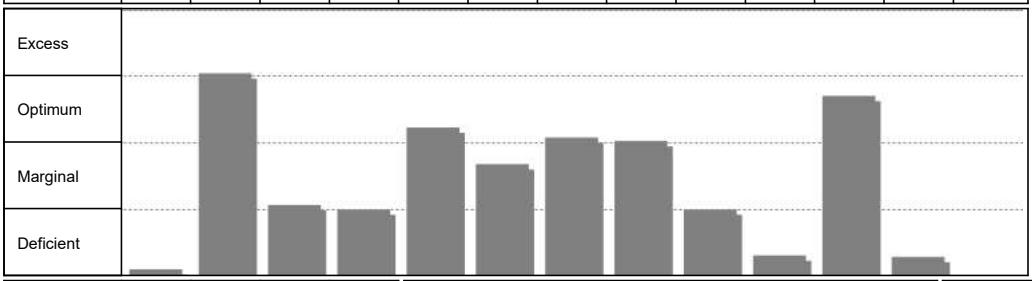
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628645
		Field Id:	SP17-1-1	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	68	80	2	384	44	89.3	0.9	<0.5	0.1	35.9	1	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
6.8	0.07	1.9	7511978



Alkaline	*Extreme*	*High*
Neutral	*Very High*	*Normal*
Acidic	*High*	*Low*
Very Acidic	*Good*	*Very Low*

	N	P	K	S
Total lbs/acre	4	137	160	4
Estimated lbs/acre	8	137	160	8

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 2.5 meq/100 g
Ca 77.3 % Mg 14 % Na <5.3 % K 8.3 %
TEC 2.5 meq/100 g Na <30 ppm

Lime 0 T/ac Buffer pH 7.4 Est. N Release n/a K/Mg Ratio 0.57

*Nitrate-N **Sulfate-S n/a = not analysed

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	100	0	68	18	1.5	10	0	70	18
Average	2.8	76	0	56	14	1.2	9	0	65	17
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 160	0 / 47	0 / 202	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	7.0	2.0	0.0	0.0	0.0	7.0	2.0	0.0

Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.
This soil is high in sodium (sodic).

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Farm Soil Analysis

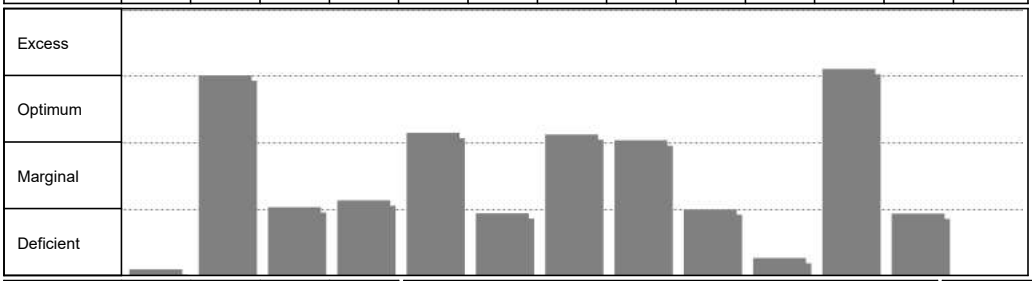
Bill To:	PGL Environmental	Grower Name:		Lot Number:	1496409
Report To:	PGL Environmental	Client's Sample Id:		Report Number:	2628646
		Field Id:	SP17-1-2	Date Received:	Jun 02, 2021
	1500 - 1185 West Georgia	Acres:		Disposal Date:	Jul 02, 2021
	Vancouver, BC., Canada	Legal Location:		Report Date:	Jun 07, 2021
	V6E 4E6	Last Crop:	Crop not provided	Arrival Condition:	
Agreement:	113516				

Nutrient analysis (ppm)

Depth	N*	P	K	S**	Ca	Mg	Fe	Cu	Zn	B	Mn	Cl	BiCarbP
0" - 6"	<2	63	78	3	320	28	134	1.0	<0.5	0.1	66.4	4	

Soil Quality

pH	EC(dS/m)	OM(%)	Sample#
6.7	0.06	1.5	7511979



Alkaline	*Extreme*	*High*	
→ *Neutral*	*Very High*	*Normal*	
Acidic	*High*	→ *Low*	
Very Acidic	*Good*	*Very Low*	

Total lbs/acre	4	125	155	5
Estimated lbs/acre	8	125	155	11

Texture *n/a* Hand Texture *n/a*
Sand n/a Silt n/a Clay n/a
Ammonium n/a

BS 100 % CEC 2.0 meq/100 g
Ca 78.7 % Mg 11 % Na <6.4 % K 9.8 %
TEC 2.0 meq/100 g Na <30 ppm

Lime 0 T/ac Buffer pH 7.4 Est. N Release n/a K/Mg Ratio 0.86

**Nitrate-N* ***Sulfate-S* *n/a = not analysed*

RECOMMENDATIONS FOR BALANCED CROP NUTRITION

	Hay - Grass					Alfalfa - New				
Macro-nutrients	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**	**Yield**	**N**	**P_2O_5**	**K_2O**	**S**
Growing Condition	T/ac	To be added (lbs/acre)				T/ac	To be added (lbs/acre)			
Excellent	4.2	101	0	70	16	1.5	10	0	73	16
Average	2.8	77	0	58	12	1.2	9	0	68	15
Your Goal	0.0					0.0				
Removal Rate (Seed/Total)	4.2	0 / 160	0 / 47	0 / 202	0 / 20	1.5	0 / 96	0 / 23	0 / 99	0 / 10
Micro-nutrients	Iron	Copper	Zinc	Boron	Manganese	Iron	Copper	Zinc	Boron	Manganese
To be added (lbs/ac)	0.0	0.0	7.0	2.0	0.0	0.0	0.0	7.0	2.0	0.0

Incorporate the recommended rate of Zinc or seed place 1 lb/ac.
Add Boron or try a test strip.
This soil is high in sodium (sodic).

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